FARGO CITY COMMISSION AGENDA
Tuesday, February 22, 2022 - 5:00 p.m.

City Commission meetings are broadcast live on TV Fargo Channel 56 and online at www.FargoND.gov/streaming. They are rebroadcast Mondays at 5:00 p.m., Thursdays at 7:00 p.m. and Saturdays at 8:00 a.m. They are also included in the video archive at www.FargoND.gov/citycommission.

A. Pledge of Allegiance.

B. Roll Call.

C. Approve Order of Agenda.

D. Minutes (Regular Meeting, February 7, 2022).

CONSENT AGENDA – APPROVE THE FOLLOWING:

1. 2nd reading and final adoption of the following Ordinances; 1st reading, 1/24/22:
   a. Relating to Hotel and Rooming-House Registers.
   b. Relating to the Human Relations Commission.
   c. Relating to Driving While License Suspended or Revoked-Impoundment of License Plates.

2. Applications for Games of Chance:
   a. Red River Valley Figure Skating Club-Fargo Ice Show for a raffle on 3/13/22.
   b. St. Mary's Cathedral for a raffle on 5/1/22.
   c. Safari Club International North Dakota Chapter for a raffle board on 3/11/22.
   d. Chuck Sornsin Benefit Fund for a raffle on 4/9/22; Public Spirited Resolution.
   e. Knights of Columbus 6570 for a calendar raffle from 4/1/22 to 4/30/22.

3. Gaming Site Authorization for Fargo Post 2 Baseball Club at Herd and Horns.

4. Memorandum of Offer to Landowner for Easement (Temporary Construction Easement), Permanent Easement (Storm Sewer) and Permanent Easement (Levee and Retaining Wall for Flood Control) with Mark E and Barbara B. McCourt (Project No. FM-19-C).

5. Change Order No. 2 for a time extension to 5/23/22 for Project No. FM-19-E1.

6. Bid advertisement for Project No. TM-22-A.

7. EAP Full-Service Contract for Services - Employee Assistance Program with The Village Business Institute.

8. Administrative Services Agreement with MissionSquare to provide the 457 plan (formerly ICMA).

9. Sole Source Procurement with OverDrive, Inc. to provide e-content for the Fargo Public Libraries (SSP22012).

10. Grant through the ND Council on the Arts for the Red River Valley Kids Read.

11. Cass County, North Dakota Drug Task Force Memorandum of Understanding.

12. Bid award for water main repair materials, miscellaneous water distribution materials, fire hydrants/parts and miscellaneous street materials (RFP22021).

13. Bid award for aggregate materials, concrete, asphalt and emulsified asphalt (RFP22020).

14. Authorize the Transit Director to negotiate a one year extension to the First Transit Services, Inc. contract.

15. Change Order No. 1 in the amount of $8,321.11 for the MTG Pit Repairs and Hoist Replacement Project (RFQ21072).

16. Bills.

17. Create the following Improvement Districts:
    a. No. PR-22-F.
    b. No. TN-22-A.

REGULAR AGENDA:

18. **RESIDENT COMMENTS (Fargo residents will be offered 2.5 minutes for comment with a maximum of 30 minutes total for all resident comments. Residents who would like to address the Commission, whether virtually or in person, must sign-up at FargoND.gov/VirtualCommission).**

19. ***Public Input Opportunity* - PUBLIC HEARINGS - 5:15 pm:**
    a. Ohmer's Addition (1258 Broadway North); approval recommended by the Planning Commission on 1/4/22:
        1. Zoning Change from SR-2, Single-Dwelling Residential and MR-2, Multi-Dwelling Residential to P/I, Public and Institutional with a C-O, Conditional Overlay.
        2. 1st reading of rezoning Ordinance.

    b. Application for a Class "GH" Alcoholic Beverage License for United States Axe LLC d/b/a United States Axe to be located at 4265 45th Street South, Suite 147.

20. Presentation of the TischlerBise Economic Incentive Program White Paper.

21. Proposed Ordinance Repealing Section 2-0106 (term limits) and proposed Resolution proposing new term limits Ordinance to be submitted for City-wide vote.

22. Commissioner Gehrig would like to discuss the negative effects of masking, especially in children.

23. Masking as a Pandemic Mitigation Strategy.

24. Recommendation for Sole Source Procurement with Interface Studio, Inc. for continued Downtown InFocus Plan work (SSP22027).

25. Recommendation for Sole Source Procurement with czb, LLC for implementation of the Core Neighborhoods Master Plan (SSP22028).

26. Recommendation to sell City owned property at 1 2nd Street South.

27. Discussion and consideration of offers for 419 3rd Street North.

28. Report on the Firearms ruling.

29. Recommendation to reject all bids and rebid in October of 2022 for Improvement District No. BR-22-A1 (32nd Avenue South Reconstruction Project).

30. Flood Update.

31. Applications for Property Tax Exemptions for Improvements Made to Buildings:
    a. Glenn and Ann Shamdas, 3024 37th Avenue South (5 year).
    b. Karen L T/O/D Breivold, 405 23rd Avenue North (5 year).
    c. Richard and Charlotte Feldman, 3301 Bohnet Boulevard North (5 year).
    d. Kathryn Ulmer, 1253 11 1/2 Street North (5 year).
    e. Aaron Wolters, 2013 30th Avenue South (5 year).

People with disabilities who plan to attend the meeting and need special accommodations should contact the Commission Office at 701.241.1310 at least 48 hours before the meeting to give our staff adequate time to make arrangements.

Minutes are available on the City of Fargo website at www.FargoND.gov/citycommission.

19a

City of Fargo Staff Report			
Title:	Ohmer's Addition	**Date:** **Updated:**	12/29/2021 2/17/2022
Location:	1258 Broadway North	**Staff Contact:**	Donald Kress, planning coordinator
Legal Description:	Block 4, Ohmer's Addition		
Owner(s)/Applicant:	Immanuel Lutheran Church	**Engineer:**	None
Entitlements Requested:	**Zone Change** (from MR-2, Multi-Dwelling Residential and SR-3, Single-Dwelling Residential to P/I, Public and Institutional with a conditional overlay (C-O))		
Status:	City Commission Public Hearing: February 22, 2022		

Existing		Proposed
Land Use: Religious institution		**Land Use:** No change
Zoning: MR-2, Multi-Dwelling Residential and SR-3, Single-Dwelling Residential		**Zoning:** P/I, Public and Institutional with a conditional overlay
Uses Allowed: MR-2 allows detached houses, attached houses, duplexes, multi-dwelling structures, daycare centers up to 12 children, group living, parks and open space, religious institutions, safety services, schools, and basic utilities **SR-3** allows detached houses, daycare centers up to 12 children, attached houses, duplexes, parks and open space, religious institutions, safety services, schools, and basic utilities		**P/I** – Public and Institutional. Allows colleges, community service, daycare centers of unlimited size, ~~detention facilities~~, health care facilities, parks and open space, religious institutions, safety services, schools, ~~offices, commercial parking~~, outdoor recreation and entertainment, ~~industrial service, manufacturing and production, warehouse and freight movement, waste related use, agriculture, aviation, surface transportation, and major entertainment events.~~ **Conditional overlay prohibits some uses as shown.**
Maximum Density Allowed: MR-2 allows a maximum density of 20 dwelling units per acre (du/ac); SR-3 allows a maximum of 8.7 du/ac		**Maximum Density Allowed:** P/I does not allow residential uses. **Maximum Lot Coverage:** Maximum 85% building coverage

Proposal:

The applicant requests one entitlement:

1. A zoning change from MR-2, Multi-Dwelling Residential and SR-3, Single-Dwelling Residential to P/I, Public and Institutional with a conditional overlay (C-O)

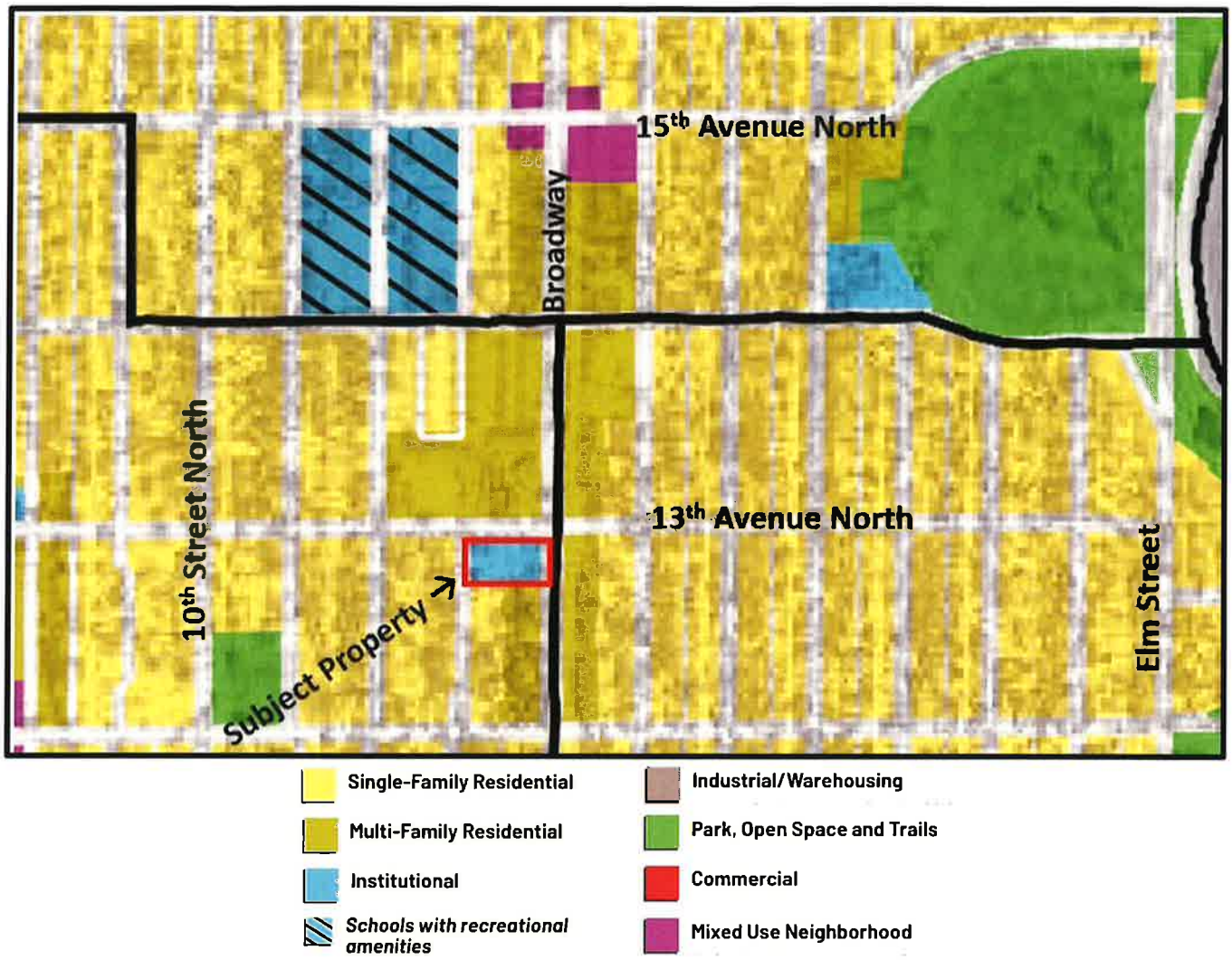
This project was reviewed by the City's Planning and Development, Engineering, Public Works, and Fire Departments ("staff"), whose comments are included in this report.

Surrounding Land Uses and Zoning Districts:

- North: MR-2 with multi-dwelling residence
- East: MR-2 with detached residences
- South: MR-2 and SR-3 with detached residences and religious institution
- West: SR-3 with detached residences

Area Plans:

The subject property is located with the 2021 Core Neighborhoods Plan, which designates the subject property for Institutional land use. That plan states that religious institutions are among the uses to be found in areas designated for Institutional land use. The P/I, Public and Institutional zone is consistent with this land use designation. No growth plan amendment is required for this zone change.



Context:

Schools: The subject property is located within the Fargo School District and is served by Roosevelt Elementary, Ben Franklin Middle and Fargo North High schools.

Neighborhood: The subject property is located in the Roosevelt neighborhood.

Parks: Roosevelt Park (1220 9th Street) is located approximately 0.2 miles southwest of the subject property. This park provides amenities of hockey rink, outdoor skating, picnic tables, a playground, restrooms, an indoor shelter space available for rent in the summer and a warming house.

Pedestrian / Bicycle: There are no trails adjacent to the subject property.

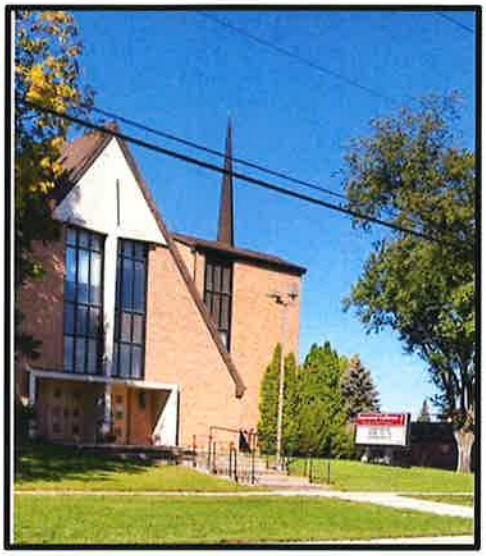
Bus Route: The subject property is located along MATBUS Route 11 with a shelter across 13th Avenue from the subject property.

Staff Analysis:

ZONING AND CONDITIONAL OVERLAY:
The property is currently in two zones, MR-2 and SR-3. Rezoning the property to P/I creates a single zone for the property that is consistent with the Core Neighborhoods Plan designation and with the use on the property. The intent of the conditional overlay (C-O) is to limit allowable land uses to those that would be compatible with the neighborhood, in order to insure predictability of any future development or activities on this property. Note that residential uses are not allowed in the P/I zone. The zone change would also allow

the existing sign to be brought into conformance (see EXISTING SIGN below). A copy of the draft conditional overlay is attached.

EXISTING SIGN:
The existing sign, located along the Broadway frontage of the subject property, is shown in the photos below:



This sign was approved in 1993, prior to the current Land Development Code and Sign Code regulations. Thus, it is a non-conforming sign and cannot be modified under the current SR-3 and MR-2 zoning on the property. If the zone change to the P/I zone is approved and the applicant decides to modify the existing sign, such modification would be regulated by the Sign Code (Fargo Land Development Code Sections 20-1301 through 20-1312).

Regarding the concerns expressed in the comment e-mails received about a possible electronic messaging center signs (see NEIGHBORHOOD COMMENTS below), Section 20-1307.J. of the Sign Code regulates frame effects and background animation; number of electronic messaging center signs allowed on the property, and sign brightness of electronic messaging center signs. Additionally, the proposed conditional overlay limits the size of any future electronic messaging sign.

NEIGHBORHOOD MEETING:
A neighborhood meeting, organized by Planning Department staff, was held on November 18, 2021 at City Hall to provide residents and property owners in the area an opportunity to meet with Immanuel Lutheran Church representatives to review and comment on this proposed change in zoning. Property owners in the surrounding 300 feet were notified of the meeting. Attendees included a representative of the Roosevelt Neighborhood Association and a neighboring property owner. Neither attendee opposed the project.

NEIGHBORHOOD COMMENTS: Attached are copies of e-mails received from neighborhood residents regarding the proposed zone change. The main concern appears to be potential modification of the sign to include electronic messaging. One e-mail is from the Roosevelt Neighborhood Association.

Zoning
Section 20-0906. F (1-4) of the LDC stipulates the following criteria be met before a zone change can be approved:

1. **Is the requested zoning change justified by a change in conditions since the previous zoning classification was established or by an error in the zoning map?**
   The subject property is in two zones--SR-3, Single-Dwelling Residential and MR-2, Multi-Dwelling Residential--due to a lot combination that was not a subdivision.

The existing sign was permitted in 1993 and was made non-conforming by the adoption of the 1998 LDC. Thus, the sign cannot be modified under the current zoning.
(Criteria Satisfied)

2. **Are the City and other agencies able to provide the necessary public services, facilities, and programs to serve the development allowed by the new zoning classifications at the time the property is developed?**
   Yes. The subject property fronts on existing public rights of way which provide access and utility services. No new development is proposed.
   (Criteria Satisfied)

3. **Will the approval of the zoning change adversely affect the condition or value of the property in the vicinity?**
   Staff has no documentation or evidence to suggest that the approval of this zoning change would adversely affect the condition or value of the property in the vicinity. Written notice of the proposal was sent to all property owners within 300 feet of the subject property. To date, Planning staff has received four e-mails regarding the proposed zone change (copies attached) and also received and responded to two inquiries. Staff finds that the approval of the zoning change will not adversely affect the condition or value of the property in the vicinity.
   (Criteria Satisfied)

4. **Is the proposed amendment consistent with the purpose of this LDC, the Growth Plan, and other adopted policies of the City?**
   The LDC states "This Land Development Code is intended to implement Fargo's Comprehensive Plan and related policies in a manner that protects the health, safety, and general welfare of the citizens of Fargo."

   The subject property is included in the Core Neighborhoods Plan (CNP) and is designated on the Future Land Use Plan of the CNP as for Institutional land uses, which include religious institutions. The proposed zoning of P/I, Public Institutional is consistent with that land use designation. The proposed conditional overlay is intended to insure predictability for and neighborhood compatibility with any future development or activities on this property.
   (Criteria Satisfied)

Staff Recommendation:

Suggested Motion: "To accept the findings and recommendations of the Planning Commission and staff, and hereby waive the requirement to receive the rezoning Ordinance one week prior to the first reading and place the rezoning Ordinance on for first reading, and approve the proposed zone change from MR-2, Multi-Dwelling Residential and SR-3, Single-Dwelling Residential to P/I, Public and Institutional with a conditional overlay (C-O) as the proposal complies with the standards of Section 20-0906.F (1-4) of the LDC and all other applicable requirements of the LDC."

Planning Commission Recommendation: January 4, 2022

At the January 4, 2022 Planning Commission hearing, by a vote of 6-0 with two Commissioners absent and three Commission seats vacant, the Planning Commission moved to accept the findings and recommendations of staff and recommended approval to the City Commission of the proposed zone change from MR-2, Multi-Dwelling Residential and SR-3, Single-Dwelling Residential to P/I, Public and Institutional with a conditional overlay (C-O) as the proposal complies with the standards of Section 20-0906.F (1-4) of the LDC and all other applicable requirements of the LDC.

Attachments:

1. Location Map
2. Zoning Map
3. Draft Conditional Overlay
4. Public comments

Zone Change (SR-2 & MR-2 to P/I) with a Conditional Overlay (C-O)

Ohmers Addition

1258 Broadway N

THE CITY OF Fargo FAR MORE

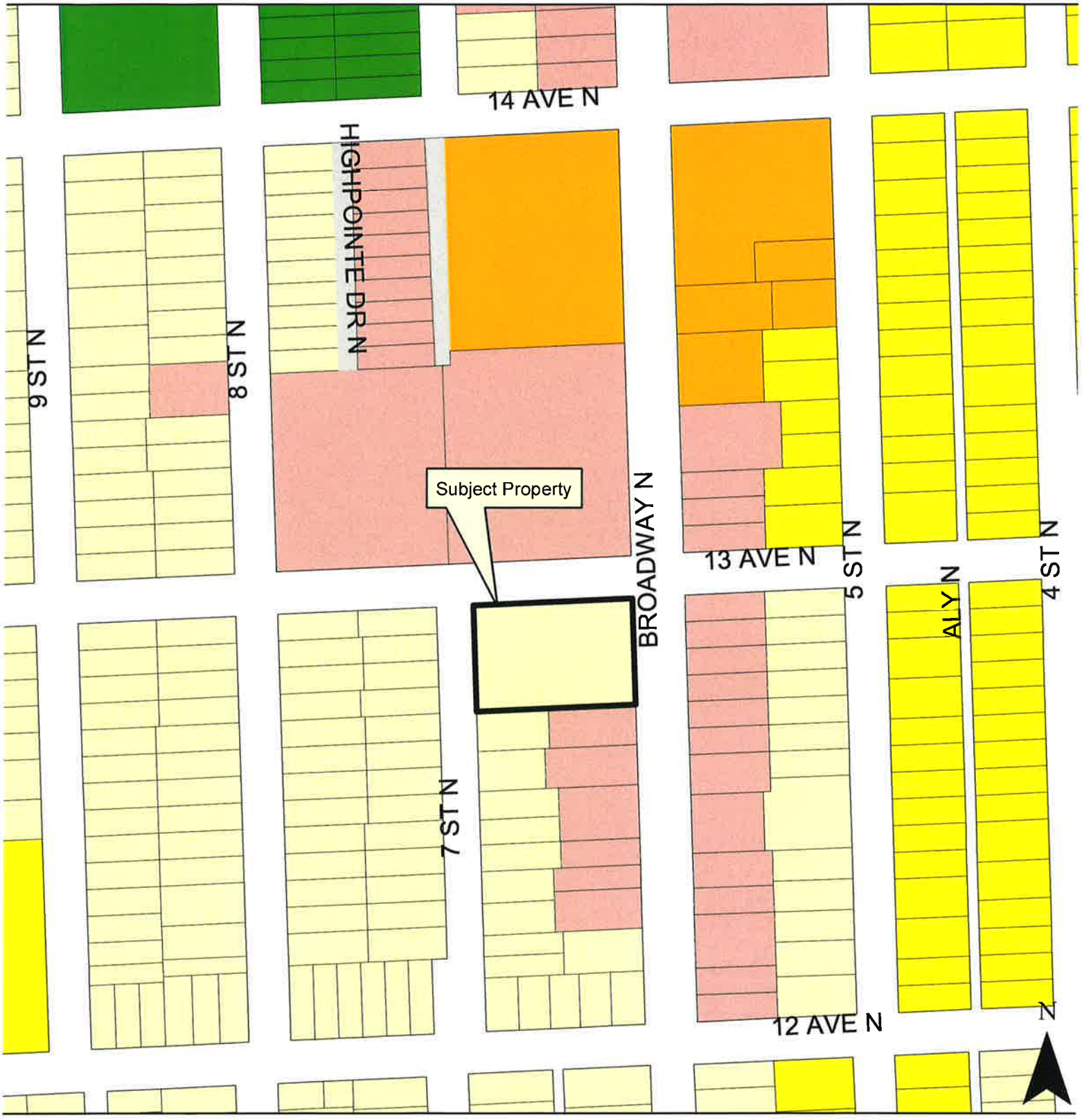
300 Feet

Fargo Planning Commission
January 4, 2022

Zone Change (SR-2 & MR-2 to P/I) with a Conditional Overlay (C-O)

Ohmers Addition

1258 Broadway N



THE CITY OF Fargo FAR MORE

Legend

AG, DMU, GC, GT, GO, LC, LI, MR-1, MR-2, MR-3, MHP, NC, NO, P/I, UMU, SR-2, SR-3, SR-4, SR-5, City Limits

300 Feet

Fargo Planning Commission
January 4, 2022

CONDITIONAL OVERLAY **DRAFT** **29 December 21**

Block 4, Ohmer's Addition is rezoned from SR-3 Single-Dwelling Residential, District and MR-2, Multi-Dwelling Residential District to "P/I", Public and Institutional, District, with a "C-O", Conditional Overlay" as follows:

1) The following use (s) are allowed:

a. Colleges
b. Community Service
c. Daycare Centers of unlimited size
d. Health Care Facilities
e. Parks and Open Space
f. Religious Institutions
g. Safety Services
h. Schools
i. Outdoor Recreation and Entertainment

All other uses are prohibited

2) For the purposes of evaluating the maximum sign face area of an electronic messaging center, Broadway North will be considered a local street.

From: jan mueller
Sent: Thursday, November 18, 2021 9:39 AM
To: Donald Kress <dkress@FargoND.gov>
Subject: Immanuel Lutheran Church

If the church changes their zoning, will it increase our taxes? We live across the street on Broadway. Also, they already have a bright sign in front of the church that is on all night. I understand they want to put up a new sign. Will it be even brighter? Currently between the street light(which we appreciate) and their sign it is already very bright. Never understood why a locked church needs the sign on through the night. Anyway , nothing brighter would be appreciated What does the change in zoning mean for neighboring blocks?
Does not look like I can make it to the meeting! Can I get answers via email? Or regular mail?
Thanks for any response.
Sent from my iPhone

From: Alex Rinehart
Sent: Thursday, November 18, 2021 5:18 PM
To: Donald Kress <dkress@FargoND.gov>
Subject: Immanuel Lutheran Church - opposed rezoning

Hello,

We live catty-corner (cross Broadway) to Immanuel Lutheran Church and we do not support the proposed rezoning. We feel the light from a new sign would be disruptive to my family, child, and neighborhood overall. We think the sign they have now is perfectly fine. I could not attend today's meeting but wanted to let you know our opinion.

Thank you for your time,

J Alex Rinehart
1301 Broadway N

From: HAROLD A [*Representing Roosevelt Neighborhood Association*]
Sent: Thursday, December 9, 2021 3:22 PM
To: Donald Kress <dkress@FargoND.gov>
Cc: Ken Enockson; Jim Laschkewitsch
Subject: Re: Immanuel Lutheran Church zone change

RNA officers met Tuesday to discuss. They have no problem with size and type. The only concern was the brightness of the electronic message board at night. We understand the brightness is regulated by code and expect the city will enforce it at time of permit.
I also reported that the city intends to limit the uses in the new P/I zone. Please confirm.
Harold

From: Christine Rose
Sent: Monday, November 15, 2021 8:26 AM
To: Donald Kress <dkress@FargoND.gov>
Subject: 1258 Broadway

Hi Donald

I just realized I cannot attend the meeting on Thursday. I wanted to put it in writing that I am not in favor of the re-zoning of the church especially for an electronic message center.

You have my opinion.

Thank you
Chris Rose

OFFICE OF THE CITY ATTORNEY
FARGO, NORTH DAKOTA

1aa2

ORDINANCE NO. _____

AN ORDINANCE REZONING CERTAIN PARCELS OF LAND LYING IN OHMER'S ADDITION TO THE CITY OF FARGO, CASS COUNTY, NORTH DAKOTA

WHEREAS, the Fargo Planning Commission and the Board of City Commissioners of the City of Fargo have held hearings pursuant to published notice to consider the rezoning of certain parcels of land lying in Ohmer's Addition to the City of Fargo, Cass County, North Dakota; and,

WHEREAS, the Fargo Planning Commission recommended approval of the rezoning request on January 4, 2022; and,

WHEREAS, the rezoning changes were approved by the City Commission on February 22, 2022,

NOW, THEREFORE,

Be It Ordained by the Board of City Commissioners of the City of Fargo:

Section 1. The following-described property:

Block Four (4) of Ohmer's Addition to the city of Fargo, Cass County, North Dakota, is hereby rezoned from "SR-2", Single-Dwelling Residential, District and "MR-2", Multi-Dwelling Residential, District, to "P/I", Public and Institutional, District, with a "C-O", Conditional Overlay, District as follows:

1) The following use(s) are allowed:
   a. Colleges;
   b. Community Service;
   c. Daycare Centers of unlimited size;
   d. Health Care Facilities;
   e. Parks and Open Space;
   f. Religious Institutions;
   g. Safety Services;
   h. Schools; and
   i. Outdoor Recreation and Entertainment.

All other uses are prohibited.

OFFICE OF THE CITY ATTORNEY
FARGO, NORTH DAKOTA

ORDINANCE NO. _____

2) For the purposes of evaluating the maximum sign face area of an electronic messaging center, Broadway North will be considered a local street.

Section 2. The City Auditor is hereby directed to amend the zoning map now on file in his office so as to conform with and carry out the provisions of this ordinance.

Section 3. This ordinance shall be in full force and effect from and after its passage and approval.

_____
Timothy J. Mahoney, M.D., Mayor

(SEAL)

Attest:

_____
Steven Sprague, City Auditor

First Reading:
Second Reading:
Final Passage:

THE CITY OF Fargo
FAR MORE

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AUDITOR'S OFFICE
Fargo City Hall
225 4th Street North
PO Box 2471
Fargo, ND 58108
Phone: 701.241.8108 | Fax: 701.241.8184
www.FargoND.gov

MEMORANDUM

TO: Board of City Commissioners

FROM: Steven Sprague, City Auditor

SUBJECT: Liquor License Application – United States Axe

DATE: February 17, 2022

The following application for a liquor license transfer was received by the Auditor's office and reviewed by the Liquor Control Board:

License Class:	GH Beer & Wine, food sales must exceed alcohol, no bar
Business Name:	United States Axe
Location:	4265 45th Street South
Applicants:	Nicole Knight

No issues or concerns were raised in the background check.

Liquor Control voted unanimously to approve.

The complete application is available for review in the Auditor's Office.

Motion Options include:

Move to approve the issuance of a Class GH alcoholic beverage license to United States Axe LLC d/b/a United States Axe to be located at 4265 45th Street South, Suite 147.

Fargo Police Department

To: Chief David Zibolski

From: Sergeant Carlos Nestler

Date: February 3, 2022

RE: Liquor License Application (United States Axe)

Application for a Class "GH" Alcoholic Beverage License for
United States Axe LLC dba United States Axe
to be located at 4265 45 St. S, Suite 147, Fargo

In accordance with Section 25-1505 of the Fargo Municipal Code, I have conducted an investigation into the character, reputation and fitness of the applicant listed on the supplied application.

During this investigation I examined the applicant's credit reports and public records criminal background.

The following information was discovered through this investigation:

Knight, Nicole Alexandra – Owner/Manager (Maiden Name is Johnson)

Criminal History-	A search of Fargo Police Department criminal records, North Dakota public records (publicsearch.ndcourts.gov), Minnesota public records (https://chs.state.mn.us/), Nashville and Davidson County TN Court Records (https://sci.ccc.nashville.gov/) and Dallas County Court Records (www.dallascounty.org/services/record-search/) showed no criminal activity.
Credit History-	Nicole A. Knight's credit report was reviewed. There are no prior bankruptcies, past due accounts or debts turned over to collections.

Fargo Police Department

Investigation Notes

This application is for a "GH" alcoholic beverage license (authorizes the licensee to sell beer, wine and sparkling wine "on-sale" only, served at table or booth, no bar. Requires 50% food sales) for United States Axe LLC dba United States Axe, located at 4265 45th St. S. Suite 147, Fargo, ND.

I spoke to Nicole Knight on February 3, 2022, by phone. I asked her if anything has changed regarding her criminal history. She said nothing has changed and she has never been arrested or charged with a crime, which is consistent with my findings. Nicole said she will be the manager for a while until she feels comfortable enough with hiring a manager. She will inform Steve Sprague when and if she hires a manager so a background check can be conducted.

I asked Nicole about the drawing of her business, specifically about the "Bar with Seating" portion. She said she has talked to Steve and there will be no bar. She is working with an architect to design the new layout.

The investigation into the criminal and credit history of the applicant did not find any issues related to criminal activity or any problems with her credit.

Business Location

United States Axe is located at 4265 45th St. S. Suite 147 in Fargo. Other businesses in the area with an alcoholic beverage license include: Hornbacher's Wine & Spirits, Lucy's North China Cuisine, SouthTown PourHouse, Tacos Trompo and The Bulldog Tap.

Conclusion

This background investigation is being forwarded for your review and recommendation to the City of Fargo Liquor Control Board.

C. Nesseth #086

NOTICE OF HEARING

Application for Alcoholic Beverage License

Notice is hereby given that the Board of City Commissioners of the City of Fargo, North Dakota, will conduct a Public Hearing in the City Commission Room, City Hall, on Tuesday, February 22, 2022 at 5:15 o'clock p.m. to consider an application for a Class "GH" Alcoholic Beverage License for United States Axe LLC dba United States Axe, to be located at 4265 45 St S, Suite 147, Fargo.

Any interested person may appear and will be heard.

City Auditor's Office
(February 2, 2022)

Please return to
Auditors office
by 2/7/22
thx

THE CITY OF Fargo

APPLICATION FOR ALCOHOLIC BEVERAGE LICENSE

Legal Company Name: United States Axe LLC
(Must match State of North Dakota registration name)

DBA Name: United States Axe

Business location address: 4265 45th Street Suite 147 Fargo ND 58104

Mailing address: 2102 Veterans Drive Saint cloud MN 56303

Business E-mail address: info@unitedstatesaxe.com

Local Manager E-mail address: nikithe knight@gmail.com

Best Contact Phone number: (612) 532 8563

Anticipated Date of Opening: Already open

Please contact the Auditor's Office at 701-241-1301 or 241-8108 to determine the appropriate License Classification Type that would fit your business model.

The following section to be completed by City Staff:

Date Received by Auditor's Office: 1-11-22

Investigations Fee Paid ($250) ✓ Yes ____ No Date Paid: ____ Check/CC# 20264

Class of License: GH Transfer: ___Yes ✓ No

Police Department review completed by: Sgt. Carlos Nestler Date: 02-02-2022
(Attached recommendation report):

X Approval Recommendation ____ Denial Recommendation

David B. Jr
Chief of Police

02-04-22
Date

THE CITY OF Fargo FAR MORE

(20)

February 22, 2022

To: **Board of City Commissioners**
Fr: **Michael Redlinger, Assistant City Administrator**
Re: **TischlerBise Economic Incentive Program White Paper Presentation**

Background: In April 2021, TischlerBise was identified as a consultant with specialized expertise in economic development analysis for municipal governments that utilize economic development and redevelopment incentives. TischlerBise assists local governments by creating studies and models that evaluate short-, medium-, and long-term economic impacts and return on investment scenarios for projects. A scope of work for the City of Fargo was developed by TischlerBise and approved on September 7, 2021 by the City Commission.

At the February 22, 2022 City Commission meeting, Colin McAweeney from TischlerBise will provide a presentation on the findings of the firm and their evaluation of Fargo's economic development incentives program. The Economic Development incentives Committee will receive a similar report at its February 22, 2022 meeting.

Study Tasks: Below is a summary of the study tasks TischlerBise developed in response to the City's request for services. These tasks included:

- **Task 1**: Project Initiation – Establishing a baseline of City of Fargo data and land use information for the study.
- **Task 2**: Preparation of a White Paper on Economic Development Incentives. This will be a comparative analysis of the City of Fargo's economic development incentives and how these compare to other cities (with an emphasis on Midwest cities).
- **Task 3**: Develop Economic Impact Model – The development of a modeling tool to evaluate the performance of Fargo's tax incentives.
- **Task 4**: Implement Economic Impact Model – A training session for City staff on the functionality and features of the model.

The February 22, 2022 City Commission presentation will focus on Task 2 – the comparative White Paper. TischlerBise will also meet with City staff to review Tasks 3 and 4 and provide training on the Economic Impact Model described above.

Recommended Action: Receive and file the TischlerBise Economic Incentive Program White Paper and receive a presentation from the consultant.

Attachment: City of Fargo Economic Incentive Program White Paper

Economic Incentive Program White Paper

Prepared for:
City of Fargo

February 1, 2022

Prepared by:

TischlerBise
FISCAL | ECONOMIC | PLANNING

4701 Sangamore Road
Suite S240
Bethesda, Maryland 20816
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www.tischlerbise.com

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www.tischlerbise.com

Executive Summary

TischlerBise has taken a multifaceted approach to examine Fargo's current economic development incentives and provide policy recommendations for the City to continue supporting local business development while also preserving public dollars. The white paper includes a survey of academic research regarding local development incentives, survey of comparable cities, case studies of successful and failed programs, and our industry leading experience in development impact analysis and municipal finance.

Currently, the City offers a comprehensive portfolio of development incentives. There have been years of success encouraging suburban growth with the special assessment districts and a complete transformation of downtown that was facilitated largely by the City's Renaissance Zone, PILOT programs, and other TIFs and incentives. Specifically, in the Renaissance Zone, over the past 20 years the total assessed value has gone up by $349 million, more than twice as fast as inflation and faster than the appreciation of the city's housing market. However, there are still nearly 30 sites that have been identified in the Renaissance Zone that could be potential candidates for redevelopment and, conservatively, would add another million square feet of new development.

Academic research and case studies provide a number of different possibilities; however, every city's culture and values are different and development incentives need to match. For example, in Paducah, KY there is a long history of cultural heritage, trade, and artists. To encourage the purchase and renovation of decaying homes in a blighted area, Paducah established an incentive program encouraging artists to move to Paducah and create live/work studios. There was natural synergy between the existing residents, the history of the town, and the program's applicants. With that said, there are a few general keys to success highlighted in research:

- Target industries with a high job multiplier
- Target exporters of products and services
- Target certain areas of a community

Found through research, direct tax incentives tend to have a higher cost than programs that provide business services, especially to small- and medium-size businesses. There are a variety of actions a locality can undertake to encourage business and remove barriers. This includes events for entrepreneurs, business incubators, job training, and assistance in the development review process. Success will come from understanding the current needs for local businesses.

When examined from different perspectives, Fargo has been very successful strategically implementing a variety of incentive programs and has one of the most comprehensive toolkits to encourage development. Fargo's economic and planning policies have encouraged significant single family and multifamily development; rejuvenated the downtown; and have battled against blighting neighborhoods. However, there are still unmet economic and housing goals for the downtown and progress needed in other Core Neighborhoods. Additionally, TischlerBise did not find significant evidence that residential and

commercial growth will continue in the future at the same pace without incentives. However, evaluation of public subsidies to private business is a prudent policy and indicative of Fargo's balance and level-headed decision making. To preserve the positive momentum of growth in Fargo while being stewards of the taxpayers' dollars TischlerBise does not recommend a total overhaul of the City's policies. Rather, TischlerBise recommends a few adjustments be made. Below is a summary, but a further explanation can be found in the body of this report.

- **Limitations to incentive packages.** Businesses tend to be shortsighted when forecasting revenues, so current incentive packages should be shortened from a maximum of 20 years to better reflect the business decision process. Also, Fargo should target industries that have a high job multiplier or will generate significant retail sales. In both cases, additional revenue will be generated to the City's budget allowing for a portion of the incentive package to be mitigated.

- **Removal of the new residential housing exemption.** Although a benefit to residents of new construction, the benefit is quite small relative to overall housing costs, so it does not appear to influence the buyer's decision, while limiting the City revenues. The exemption is available in neighboring communities, but the strength of Fargo's market will outweigh the value of the tax incentive to new home buyers.

- **Explore new parking opportunities, land banking, and waterfront development programs.** Previous parking structure projects have provided necessary space for office, commercial, and residential growth while freeing up surface parking for redevelopment. Downtown parking was reaching capacity before the covid-19 pandemic and as the downtown continues to grow its full-time residential population and commercial development the City should explore any opportunities that would bring further parking into the downtown. Land banking and waterfront development would be new to the City and require further analysis to understand its impact. However, a third-party land trust has just formed in the Fargo area and these policies can be a low-risk approach to providing affordable housing in blighted neighborhoods. Additionally, other communities have had tremendous success developing and commercializing their waterfront, providing a potential playbook for Fargo. Large capital funding is necessary, but state, federal, and private investments have a history of cooperation towards the goal of waterfront development.

Lastly, following this white paper, TischlerBise will be developing and implementing an economic impact model for the City. The model will be available to staff to understand the direct, indirect (spin-off) and induced economic impacts, such as jobs, and retail sales from proposed developments applying for development incentives. This model will provide a framework from which the City can begin to measure the economic return on its investment.

Fargo Economic Incentives

The City of Fargo has been taking advantage of several different incentive programs to encourage a wide variety of development for decades. Such programs existed nationally well before being introduced in Fargo. However, the City has been a trailblazer in the State of North Dakota. Incentive programs foster a pro-business environment and have the ability to shape a community's economic future. By many accounts, Fargo's incentive programs have assisted residents and local businesses. Nevertheless, economic incentive programs do not always end in success stories and are ripe for political controversies at the cost of public tax dollars. Furthermore, incentives may be perceived as the public subsidizing private business development, especially if the growth is thought to occur without being incentivized. With that said, it is important for communities to periodically evaluate their incentive programs to understand the effectiveness and if incentives are still necessary for economic development.

The following chapter provides a summary of incentives that the City of Fargo currently has in its toolbox. It should be noted that regional, state, or federal incentive programs are not included in this report. The chapter will also provide a deeper dive into the City's Renaissance Zone program.

Current City Incentives

Much of the following summary has been made available by the City in the recently adopted *Economic Development Incentive Polices & Guidelines Report (December 2021)* and the *Fargo Renaissance Zone Development Plan (2020)*.

Residential New Housing Exemption

This exemption promotes the construction of dwelling units thereby encouraging the volume of employment, enhancing living conditions, and increasing the tax base.

Summary of guidelines:

- This exemption allows for a two-year exemption of up to $150,000 in value on newly constructed residential dwellings, duplexes, townhomes, and condominiums,
- Exemptions are available to builders, as well as the initial owners after the builder.

Remodeling Exemption

This exemption provides an incentive to property owners to invest private capital in order to remodel and rehabilitate buildings and structures to prevent the properties from decay. It is at the discretion of the City Commission to grant this exemption to properties. The exemption encourages investment of private capital to improve properties to encourage the production of wealth, improve the volume of employment, enhance living conditions, and increase the property tax base.

Summary of guidelines:

- The five-year remodeling exemption is available to all commercial properties and residential buildings that are at least 25 years old,

- This provides for an exemption of buildings' increased values improved by means of renovation, remodeling, alteration, or additions,
- It does not apply to the replacement of one building with another.

New or Expanding Business Exemption/PILOT

The purpose of this policy is to establish the City's position relating to the use of business property tax exemptions and Payment in Lieu of Taxes (PILOT) in support of creating new primary sector jobs. The fundamental purpose is to create primary sector jobs that will expand the economy and diversify the existing economic base.

Summary of guidelines:

- A point system is be used as a guide in evaluating primary sector projects for possible incentive programs. A total of 120 points is required for recommended approval. There is a multi-point evaluation: project type, jobs created (initial year), jobs created (Year 3), hourly salaries, local competition, company safety experience rating, value of proposed building, and startup firms.

Lower Income Rental Housing PILOT

The purpose is to encourage housing developers to build housing to meet the needs of very low-income households. "Lower-Income Housing" is defined a housing for "low-income households" as defined by the U.S. Department of Housing and Urban Development, with rents not to exceed 30 percent of household income. Incentives may be for 1-20 years and for 100 percent of new buildings and substantial rehabilitation improvements.

Summary of guidelines:

- Lower income apartments are those where the developer is required to rent to lower income households at below market rent

Core Neighborhood Housing PILOT

The purpose is to encourage desirable development or redevelopment that would not otherwise occur but for the assistance. The City will consider using PILOT to assist private housing development projects to achieve affordable housing, remove blighted areas in core neighborhoods, to offset increased cost of redevelopment, and other environmental concerns. For projects without affordable housing, the maximum PILOT incentive will be a 100 percent exemption for the first five years and a 50 percent exemption for an additional five years. For projects with affordable housing, the maximum PILOT incentive will be a 100 percent exemption for a maximum of 20 years. The value of the PILOT is limited to the extraordinary costs of development.

Summary of guidelines:

- Developer must provide at least 10 percent of total capital costs as developer's equity in the project,
- Financial plans of the project will be reviewed by the City financial consultant to determine the feasibility and level of public assistance that is appropriate,

- The project must be consistent with the City's Comprehensive Plan, the Core Neighborhood Land Use Plan, and the Land Development Code.

Downtown Housing PILOT

The purpose is to encourage housing developers to build new housing downtown to create new opportunities to live downtown, bring new customers for downtown businesses, create a safer downtown with increased numbers of people downtown, and use existing infrastructure as alternative to continued apartment development on the edge of the city.

Summary of guidelines:

- Years 1-5 – 100 percent exempt on the increased value of the improvements,
- Years 6-15 – The percentage exempt will be based on a financial review and "but for" test. The amount exempt will be no more than 90 percent of the improved value,
- If market rate apartments include at least 10 percent of the housing to be what the City considers "affordable," the City may approve up to a 100 percent exemption based on a financial review and "but for" test for up to 20 years.

Tax Increment Financing (TIF)

The intent is to encourage desirable development or redevelopment of brownfield sites, slum areas, or a blighted area that would not otherwise occur but for the assistance provided through TIF. This may be provided in one of three ways: a tax exemption, the issuance of a promissory note to the project applicant, the issuance of bonds to be paid by the City from tax increment proceeds.

Summary of guidelines:

- The City has established multiple objectives that should be met to qualify for TIF. Since there are different types of developments, the objectives for each of the development types are different. The four types of anticipated projects include:
  - Housing,
  - Commercial or industrial,
  - Downtown,
  - Mixed use (commercial and housing in same development).

Renaissance Zone Incentives

The Renaissance Zone Program encourages private investment to rehabilitate or redevelop Downtown Fargo through the use of property tax, state income tax, and historic preservation & renovation tax credit incentives. The Fargo Renaissance Zone Authority administers these incentives, but all are subject to Fargo City Commission approval.

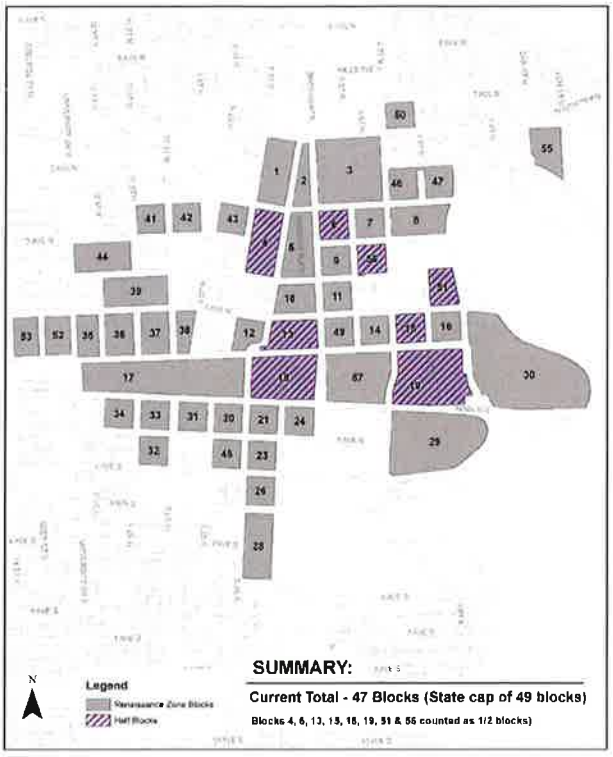
Summary of guidelines:

- Developments must be within the eligible targeted areas of the Renaissance Zone boundary,
- Minimum investment thresholds based on project type,
- Incorporate urban design that encourages street activation and historic preservation,

- Financial summary shall be submitted concurrent with application and shall document costs and the anticipated total capital investment.

Enabled in 1999 by the North Dakota Legislature, the Fargo Renaissance Zone has gone through several iterations, including expansion and modification of the boundary eight times. Through 2019, there have been 242 projects approved with the majority coming from residential purchases, commercial/mixed use rehabilitation, and tenant leases. There have been substantial new construction projects as well. The figure below illustrates the current boundaries and city blocks that are included in the Renaissance Zone.

Figure 1. Current City of Fargo Renaissance Zone[1]



Along with the incentives under the Renaissance Zone program the City has taken steps to further promote the downtown. According to City staff three other initiatives helped attract businesses downtown.

- Broadway Street was improved with road improvements, new streetscape, and building façade upgrades.
- The City constructed three parking structures allowing for other surface parking to be redevelopment without the worry of parking capacity.
- Zoning ordinances were adjusted to allow for less bureaucracy and a quicker business development timeline.

These strategies made the downtown physically and economically attractive for development. Importantly, the three parking structures expanded the capacity for more downtown employment and commercial spending. The additional parking also freed up surface parking lots to be developed. Cumulatively, the assessed value of the Renaissance Zone boundary has risen from $197 million to $546 million ($349 million increase). On average, this is a 5.23 percent increase annually. However, the increase in value is partially a product of inflation. Based on the Bureau of Labor Statistics Consumer Price Index (CPI), inflation from 1999 to 2019 averaged an annual increase of 2.15 percent. Thus, the assessed value of the Renaissance Zone has increased by nearly double the rate of inflation.

[1] City of Fargo.

Furthermore, the housing market in Fargo has been consistently strong and competitive. When the Renaissance Zone is compared to the housing market, we find that the average annual increase in assessed value in the Renaissance Zone is five percent higher than the average annual increase in median housing value in Fargo.[2] Although this is a simplified comparison of the two different property markets, it indicates that the Zone's success of promoting higher property values has been just as good, if not slightly better, than the City's housing market.

However, a component of the incentive program is property tax exemptions. The incentive package made available to redevelopment is examined on a case-by-case basis and span multiple years. As of 2021, there is $137 million in property value exemptions, or about 40 percent of the value increase since 1999. These exemptions will eventually be added to the City's tax roll based on each development's incentive package, but, until then, this represents property that is not contributing to the City's property tax revenue.

The Renaissance Zone accomplishes more than purely increasing property values. By all accounts, the past decade of effort has completely changed the public perception of downtown Fargo. Feeling safe and excited by the atmosphere, residents now spend their evenings and weekends enjoying the new shopping and entertainment, while visitors have amenities once reserved for larger cities. The quality-of-life improvements help keep the young talent studying in Fargo and attracts outside professionals. Additionally, much needed housing has been constructed downtown with the Renaissance Zone program and other incentive programs, establishing a unique and attractive urban market to Fargo.

With that said, the City has identified 16 surface parking lots and 12 redevelopment sites/buildings in the Renaissance Zone as potential future candidates for the program. The surface parking lots total 160,000 square feet which could be developed into multilevel buildings and the existing buildings total 830,000 square feet of floor area. This is a potential of over a million square feet of redevelopment downtown of undeveloped or underutilized properties. Along with providing tax base value, redevelopments have the potential to expand upon the new lifestyle experiences in the downtown and address goals that have not yet been accomplished among those being more downtown housing. Although there has already been progress in increasing the housing mix downtown, following the Downtown InFocus Plan, the City has a goal of at least 1,000 more households downtown.

Importantly, the City of Fargo collects a one-cent sales tax for infrastructure capital improvements that has benefitted from the commercial development that has occurred downtown. Sales tax revenue generation from a specific development comes in a number of forms. The most significant being if the development is a retailer. In this case, it is safe to assume that one percent of the retailer sales will be sales tax revenue to the City. When new jobs are generated, the new household income provides new retail sales tax to the City as well. This is especially true for high income earners with substantial disposable income. Furthermore, there are indirect retail sales from economic growth. These indirect sales occur when the spin-off jobs bring further spending to the economy and the business-related industries expand

[2] U.S. Census American Community Survey, 2000 and 2019 mean value of owner-occupied home estimates.

to support the new development. If the retail spending is significant enough, sales tax from the new development will be able to mitigate property tax incentives. However, this is only understood on a case-by-case analysis with sophisticated modeling. As part of TischlerBise's scope of work, an economic impact model will be constructed for the City of Fargo which will provide estimated direct, indirect (spin-off), construction phase spending, and induced economic impacts, along with estimates of retail sales.

Special Assessment Financing for Infrastructure

The City of Fargo, along with other jurisdictions in the Fargo-Moorhead region, use special assessment districts to finance new infrastructure to support growth. Traditionally, this is implemented in new subdivisions where new roads and utilities are required before homes can be constructed. Although not titled or entirely perceived as an incentive, the financing tool is a unique and successful program that shifts infrastructure cost from the developer to the future homeowners through a property assessment. However, the City of Fargo absorbs the risk since the infrastructure costs are fronted by the City when bonds are issued. The City recoups its costs when the new homeowners pay their annual property assessment. In communities without special assessments, local infrastructure costs and risk are generally the responsibility of the developer with the costs being recouped when the homes are sold. The special assessment districts do not function in the traditional sense of a tax incentive, but do provide a unique benefit to development. For that reason, they are included in the white paper.

There are four general stages of the special assessment. First, the development is proposed with an infrastructure plan included. If accepted, the City determines which infrastructure costs are directly benefitting the new residents of the development and which costs are benefitting citywide demand. The special assessment district is established along with locally benefitting projects being constructed and funded through a city-issued bond. Lastly, the bond is paid back by the future homeowner's annual property assessments.

Incentives by Comparable Cities

The figure below provides a list of local incentive programs by comparable cities. From eight comparable cities, tax increment financing (TIF), tax abatements, and land banking are the most common programs. Schaumburg provides a unique small business grant to eligible firms, while Bentonville is still building its incentive policies. However, based on the survey of the websites for each locality, the City of Fargo has a more comprehensive and thoughtful approach to economic incentives relative to its comparables.

Not listed in Figure 2 are the county, regional, and state programs available to development and businesses. Non-local programs do contribute to the profile which businesses consider when making location decisions. However, some non-local programs (such as income tax incentives) are not applicable to the City of Fargo and should only be considered at the respective governmental authority.

Figure 2. Economic Development Incentive Programs in Comparable Cities

Locality	Local Incentive Programs*	2020 Census Population
Bentonville, AR	City is currently exploring incentive options	54,164
Des Moines, IA	TIF, Tax Abatements, Land Banking	214,133
Edmond, OK	Permit Waivers, Façade/Infrastructure/ Payroll Reimbursement	94,428
Fort Collins, CO	TIF	169,810
Lee's Summit, MO	TIF, Tax Abatements, Land Banking	101,108
Lincoln, NE	TIF, Land Banking	291,082
Olathe, KS	TIF, Land Banking, Neighborhood Revitalization	141,290
Schaumburg, IL	Small Business Grants, TIF	78,723

Source: information listed is from the locality and economic development organization's website.
*Note: only the local incentive programs are listed. County, regional, and state programs are not included.

Survey of Academic Research

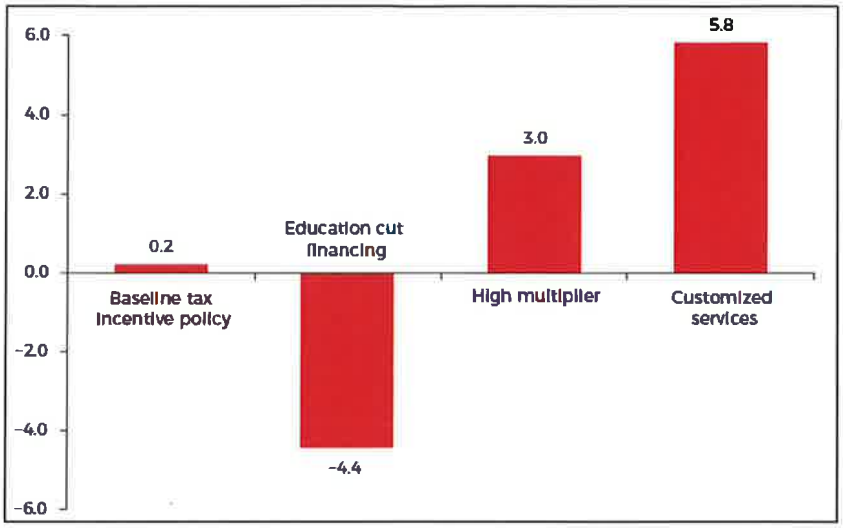
There is a long history of academic research and analysis regarding public economic development incentives. Although it is important to understand past successes and failures, programs should be evaluated within its own context. General conventions may not be applicable in specific instances, but the following summary will help Fargo construct its best practices when examining current and future incentive programs.

- Although there have been mixed results from case study analysis and meta-analysis, there is a rough consensus that local tax incentives have a positive impact. However, when local incentive programs nationally are analyzed cumulatively, those impacts have generally been observed to be "minor at best."[3]
- With that said, there are several elements a community can implement in their incentive program to ensure a more successful future:
    - Target industries with a high job multiplier. In these cases, the direct jobs created by the new business have a high spill-over effect which then supports other jobs. For example, high paying jobs will bring new spending to the local economy or the presence of a business attracting other associated businesses.[4] [5]
    - Target exporters of products and services. Companies that sell their products to external markets will inject new dollars to the local economy compared to being a direct competitor to an already existing local firm. For example, a business providing a service that is already being provided in the community will merely be cannibalizing the market.[6]
    - Target certain areas of a community. Property tax incentives are most successful in areas with high unemployment, low income, and/or under-utilized infrastructure. In these cases, there is a potential for immediate increases to household incomes and the locality will have to invest less in infrastructure improvements.[4]
- A leader in the field, Timothy Bartik, recommends that for an incentive package to be beneficial to the community there should be a limit between $10,000 to $20,000 in incentive funding per new job created. Additionally, Bartik considers most firms to be myopic and focused more on

[3] Fisher and Peters. "The Failures of Economic Development Incentives." *Journal of the American Planning Association*. Vol. 70. No. 1. Winter 2004.
[4] Bartik, Timothy J. 2018. "Who Benefits From Economic Development Incentives? How Incentive Effects on Local Incomes and the Income Distribution Vary with Different Assumptions about Incentive Policy and the Local Economy." Upjohn Institute Technical Report No. 18-034. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/tr18-034.
[5] Bartik, Timothy J. 2018. "Improving Economic Development Incentives." Policy Brief. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/pb2018-1.
[6] Pew Charitable Trusts. "What Factors Influence the Effectiveness of Business Incentives?" April 2019.

short-term gains, so an incentive program should not be very lengthy and restricted to just a few years.[7]

Figure 3. How Four Different Incentive Policies Affect State Residents: Percentage Effects on Per Capita Income[8]



- Bartik constructed an academic economic impact model to understand hypothetical incentive scenarios' effect on long-term (80 years) impact on the local household income. A few of the results are shown in Figure 3. When a baseline tax incentive program is compared to different incentive policies, several alternatives create a much greater benefit to the community's prosperity. Additionally, there is tremendous negative impact when education funding is cut to fund the incentive package.[9] Specifically, the baseline created a 0.2 percent increase to income per capita. While education funding cut to finance the incentive program resulted a -4.4 percent impact to income, targeting high multiplier industries resulted a 3.0 percent increase to income, and customized services instead of tax incentives resulted a 5.8 percent increase to income.

- The Bartik analysis highlights the success of tax alternative programs. Localities providing business services can help reduce barriers that are restricting the success of local firms. This is especially the case for small to medium business.[10] These services come in many forms, but for example, the locality can provide custom job training, be a labor market intermediary, provide regulatory assistance, or establish an incubator.[11]

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[7] Timothy, Bartik. Interview with Richard Florida. "How Cities and States Can Stop the Incentive Madness." Bloomberg CityLab. November 12, 2019.

[8] Bartik, Timothy J. 2018. "Improving Economic Development Incentives." Policy Brief. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/pb2018-1.

[9] Bartik, Timothy J. 2018. "Who Benefits From Economic Development Incentives? How Incentive Effects on Local Incomes and the Income Distribution Vary with Different Assumptions about Incentive Policy and the Local Economy." Upjohn Institute Technical Report No. 18-034. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/tr18-034.

[10] Pew Charitable Trusts. "What Factors Influence the Effectiveness of Business Incentives?" April 2019.

[11] Kenyon, Langley, Paquin. "Rethinking Property Tax Incentives for Business." Lincoln Institute of Land Policy. 2012.

- Custom job training has been found to be 10-25 times more effective in creating jobs than tax incentives.[11] For example, in manufacturing-intense communities, tax incentives had an annual cost of $16,000 per job created while custom job training incentive had an annual cost of $3,000 per job created.[12]
- From Bartik, credible studies found that average sized tax incentives have ultimately only been the deciding factor in one-fifth of business location decisions.[13]
- Although positive impacts have been observed from tax incentive programs, the practice has been found to have limitations on tipping the scale when attracting businesses. One reason is the magnitude of tax abatements compared to other business expenses. For example, the wage costs for manufacturing firms average about 11 times the value of its property tax bill. For that reason, the local salaries have more of an influence than tax incentives when a firm is making location decisions.[14] There are a multitude other location decision factors such as state/federal incentive programs, location within trade routes, connectivity to metropolitan areas, and the local ecosystem of industry and innovation.

[12] Berkaw and Desai. "Wooing Companies to Move: Are Business Incentives Worth the Cost?" Entrepreneurship Issue Brief, January 2012, Ewing Marion Kauffman Foundation, Kansas City.
[13] Bartik, Timothy J. 2018. "Improving Economic Development Incentives." Policy Brief. Kalamazoo, MI: W.E. Upjohn Institute for Employment Research. https://doi.org/10.17848/pb2018-1
[14] Fisher and Peters. "The Failures of Economic Development Incentives." *Journal of the American Planning Association*. Vol. 70. No. 1. Winter 2004.

Case Studies

The City of Fargo has been promoting economic development for decades. To support discussions around reviewing the current incentive programs and future policies in Fargo, the following chapter provides two case studies of successful incentive programs and a third case study of a program gone wrong.

Riverfront Development – Dubuque, Iowa

By 1990, the City of Dubuque had turned its back on its Mississippi River waterfront. Although adjacent to the downtown, a history of heavy industrial uses had led to brownfields with environmental issues, underutilized properties, and shuttered businesses.[15] The first step to addressing the riverfront's economic future, and the future of the city at-large, was the *Vision 2000 Long-Range Comprehensive Plan.* The comprehensive plan included elements of connecting it residents physically and psychologically with the river. Following that initiative, a partnership including the City, Dubuque County Historical Society, Greater Dubuque Development Corporation, and others produced the *Port of Dubuque Master Plan*. The Master Plan was a culmination of a ten-month community planning and design effort including a variety of committee, public, and stakeholder participation. The final design was a "Central Green" concept that would resemble a downtown pattern of interconnected streets, a high degree of development flexibility, and able to leverage current and upcoming investments.[16]

Figure 4. Port of Dubuque Master Plan Illustration of North Port[17]

Critically, funding surpassed initial goals. The America's River project initially had a fundraising goal of $25 million for revitalization of the North Port area, but that was eclipsed with a $40 million State of Iowa Vision grant. The US Environmental Protection Agency (EPA) also contributed under its brownfield revitalization program to assess and mitigate the environmental concerns. Overall, the America's River project generated $188 million in revitalization funding coalescing into five landmark achievements: the Mississippi Riverwalk, the

[15] US EPA. February 2021. *The Brownfields Broadcast: Brownfields Program Helps Dubuque, IA Leverage Investment, Reinvigorate Community*. October 2021. https://www.epa.gov/brownfields/brownfields-broadcast-brownfields-program-helps-dubuque-ia-leverage-investment.
[16] URS Corporation, Leland Consulting Group, EDG, Ltd. *Port of Dubuque Master Plan.* March 2002.
[17] Ibid.

National Mississippi River Museum and Aquarium, the Grand River Center, the Grand Harbor Resort, and the Star Brewery. All of which are celebrating historical, environmental, educational, and recreational majesty of the Mississippi River and attracting a million tourists a year.[18]

Along with State and Federal incentive programs, developments in the Port were eligible for tax incremental financing (TIF), property tax exemptions, façade grants, design grants, and land acquisition discounts. Since the inception, $400 million in public and private investment has gone towards the riverfront. Presently, the original tax exemptions have sunsetted, now contributing to the City's coffers.[19]

The success of the America's River project has been followed up by two other phases that included expanding the trail system along the water, a performing arts center, and restoration of a river tributary to a park and flood mitigation system. The economic and social benefits have expanded beyond the riverfront as well to an adjacent neighborhood, the Historic Millwork District, an old warehouse core that has been revitalized into a mixed-use neighborhood, attracting a thousand new residents and new businesses including IBM, bringing a thousand new jobs. Progress continues in the North Port riverfront as well. A recently approved mixed-use development will be bringing in much needed housing and was made possible by the City of Dubuque's TIF agreement and land acquisition grant.[20]

The riverfront development has brought important educational, cultural, and economic drivers to Dubuque that would not have occurred without the efforts and investments from both the public and private communities. North Port transformed the city's inward and outward identity by engaging in economic initiative and in turn the quality of life of residents benefited. Ultimately, the City has accomplished its goal from decades ago, reconnecting its residents to the river.[21]

Targeting Talent – Paducah, Kentucky

Direct payments and other financial support have grown in popularity. There is an increasing number of municipalities using cash and other promotions to incentive talent to relocate. Incentivizing talented workers, especially remote workers that make more the local median income, helps drive the local economy and rejuvenate neighborhoods. In Paducah, Kentucky that was exactly the intent of the Artist Relocation Program.

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[18] City of Dubuque. *Dubuque History*. October 2021. https://www.cityofdubuque.org/1060/History.
[19] US EPA. *How Small Towns and Cities Can Use Local Assets to Rebuild Their Economies: Lessons from Successful Places.* May 2015.
[20] Allison Wong. October 2019. Proposed Port of Dubuque development hopes to attract young professionals. *KCRG. https://www.kcrg.com/content/news/Proposed-Port-of-Dubuque-development-hopes-to-attract-young-professionals-562480841.html.*
[21] US EPA. October 2020. *Redevelopment Goals in Dubuque, Iowa, Come Alive by Strengthening Central Neighborhoods*. October 2021. https://www.epa.gov/ia/redevelopment-goals-dubuque-iowa-come-alive-strengthening-central-neighborhoods.

Paducah sits along the Ohio River, centrally located near five states. Historically, the city's location has been advantageous for a trade center. In 2000, there were about 26,000 residents[22] and the downtown had an outsized art and cultural presence with the William Clark Market House Museum, Market House Theater, and National Quilt Museum which drew 40,000 visitors a year.[23] However, while the downtown was thriving an adjacent neighborhood, Lowertown, was struggling and by 2002 it was considered to be in an overall blighted state with dilapidated buildings, high poverty, and high crime.[24] Figure 5 is an illustration of Paducah's downtown and Lowertown.

Figure 5. Paducah Renaissance Area Master Plan Map[25]

In 2002, Lowertown was at a crossroads and that is when the City introduced the Artist Relocation Program. Under the program, the City created a land trust which purchased 55 vacant or foreclosed buildings. Those lots were then sold to eligible artists, who met certain application requirements like a business plan, for as low as $1 with the promise that they would renovate the home. Critically important, special affordable financing options were made available by Paducah Bank which allowed investors to borrow more than the assessed value of the lot. There were reimbursements for architectural and professional services and marketing campaigns funded by Paducah. The City also made changes to its ordinances to allow for the new residents to live and work in the same residents creating an irresistible live/work environment. Maintenance and improvements were made to the roads, street lighting, and vacant lots to create a safer neighborhood as well.

In the first five years of the program, the City spent about $3 million while there was a total of $35 million in private investment, attracting more than one hundred artists.[26] By 2010, 234 new businesses were started in the art district, 119 buildings were renovated, vacancy rate fell from 70 to 14 percent, and

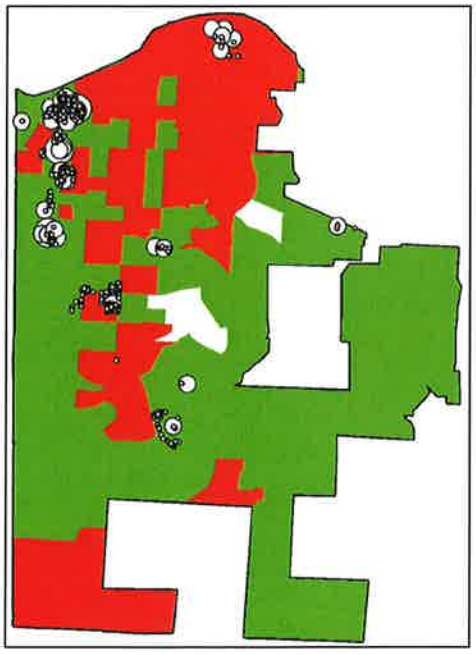
[22] US Decennial Census, 2000.
[23] US EPA. *How Small Towns and Cities Can Use Local Assets to Rebuild Their Economies: Lessons from Successful Places*. May 2015.
[24] CityVisions Associates, AECOM, ConsultEcon, HNTB. *Renaissance Area Master Plan (RAMP), Paducah, Kentucky*. December 2011.
[25] Ibid.
[26] US EPA. *How Small Towns and Cities Can Use Local Assets to Rebuild Their Economies: Lessons from Successful Places*. May 2015.

Paducah won the Great American Main Street Award by the National Trust for Historic Preservation. The arts and culture industry draws more than 400,000 annual event attendees, generating $200 million in tourism income, $39.9 million in local economic activity, $3.6 million in local and state revenue.[27] And finally in 2013, the City of Paducah was recognized by UNESCO as the world's seventh City of Crafts and Folk Art, making it a member of the UNESCO Creative Cities Network. In an NPR interview, a Paducah city planner attributes all the success to the Artist Relocation Program.[28]

Tax Increment Financing (TIF) Misused and Unguided – Kansas City & St. Louis

Tax increment financing (TIF) ultimately targets site specific capital improvements with new property tax revenue from that same development. Arguably, TIFs can have a snowball effect when increased property values are in turn used to improve infrastructure that will further increase values. This cycle can have spill-over effects to adjacent properties and neighborhoods as well. When implemented appropriately, rejuvenating development, which would not have occurred without the program, can be successful in blighted areas. However, without proper guardrails and oversight a TIF may result in public subsidies going towards development projects that benefit already successful and wealthy neighborhoods. This was observed in both Kansas City and St. Louis.

Figure 6. Kansas City Census Tracts and TIF Location[29]



A 2014 study, completed by the Show-Me Institute, examined the location of TIFs in Kansas City.[30] The analysis produced the map illustrated in Figure 6. Kansas City census tracts in Jackson County are highlighted either red for 30 percent of more residents in poverty or green for less than 30 percent of residents in poverty. Layered on top of the census tracts is the location and value of TIFs. It was found that $34.5 million of public subsidy went to impoverished areas, while $276 million of public subsidy went to affluent areas. Or eight times the value of TIFs went to affluent areas. The study further highlighted a case where the City redirected $42 million for an existing Kansas City company to build a new headquarters immediately next to its existing headquarters, a project that has very little benefit to the surrounding community.

[27] Main Street America. Great American Main Street Award. Paducah, Kentucky. 2010.
[28] Noah Adams. August 2013. *In Paducah, Artists Create Something From Nothing.* NPR. https://www.npr.org/2013/08/09/210130790/in-paducah-artists-create-something-from-nothing
[29] Tuohey and Rathbone. *Urban Neglect: Kansas City's Misuse of Tax Increment Financing*. November 2014. Show-Me Institute.
[30] Ibid.

A similar analysis and outcome were found in St. Louis. In 2017, the Show-Me Institute found that $57 million of public TIF spending went to impoverished areas while $207 million of public TIF spending went to affluent areas. Or over three times the value of spending went to affluent areas compared to impoverished areas.[31] Additionally, the study found that 7,572 jobs were attributed to the TIFs, resulting in $35,000 in subsidies per job, at best.

The St. Louis analysis continued by examining the prevalence of poverty and found that there was an overall increase in poverty throughout city and often in areas in which TIFs had been applied. Although poverty is influenced by a myriad of factors, the study found it hard to make an argument that TIFs in St. Louis are having a net positive impact at addressing prosperity for all residents. Lastly, the study highlighted a luxury apartment building that was provided a $10 million TIF, but it was unclear to the author how the project was in the public's best interest.

There were three resounding recommendations from the studies on how the cities should adjust their tax increment financing program. First, in both cities the "but-for" test is completed by the applicant. The "but-for" examines to what extent the project needs public assistance and is intended to demonstrate that but for assistance the project would not move forward. There is an obvious conflict when the applicant is supposed to be demonstrating an objective assessment of the needed assistance. Both studies recommended that a third party be responsible for the but-for evaluations. Secondly, there needs to be a more rigorous standard used to qualify projects. Projects that received public assistances under the TIF need to be in blighted areas and demonstrate that they will be an overwhelming benefit to the neighborhood. Lastly, there is a need for more accurate reporting of the jobs and other benefits produced by TIF projects. Without measurable indicators, there is no understanding of the success of the project and program. Additionally, the results of the reporting would be the first step in implementing a "clawback," where if the project fails to deliver the promised economic impact the developer would be forced to pay back a portion or all the TIF benefits.

[31] Tuohey, Highsmith, and Tuttle. *Tax-Increment Financing in Saint Louis*. September 2017. Show-Me Institute.

Recommendations

The following are recommendations regarding the future of economic development incentives in Fargo. The recommendations are based on the survey of impacts from the current incentive programs, analysis of available future development, review of academic research, understanding of successes and failures in other jurisdictions, and TischlerBise's industry-leading experience in local economic development analysis and local revenue strategies. Furthermore, the TischlerBise economic impact model developed for the City will provide empirical analysis and understanding of economic impacts of specific development proposals including spin-off job generation and sales tax revenue to the City.

Arguably, Fargo has been very successful strategically implementing a variety of incentive programs and has one of the most comprehensive toolkits to encourage development and redevelopment. Empirically and aesthetically, the downtown has been transformed by redevelopment which would not have occurred at such a quick pace without City incentives. Similarly, there has been consistent suburban growth that have been supported by its incentives and financing strategies. While further examination is needed for a few of the following recommendations, the following should be affirmation that with just a few adjustments, the City of Fargo will continue promoting a sustainable development incentive environment.

- TischlerBise recommends that the City continue with its special assessment district financing tool. Although the City takes over the risk of the infrastructure costs between the time of construction and when property assessments are collected. The financing tool allows for a more comprehensive approach to infrastructure construction and, importantly, more homes are able to be constructed by local developers and home builders since the oversized cost burden of infrastructure is shifted with the bond issuance. Additionally, the City has been strategically financing the accrued debt and able to mitigate some of the risk with revenue from interest rate margins.

- To address housing needs and goals, TischlerBise recommends continuing the PILOT housing programs and the Renaissance Zone. Housing is a crucial need for a thriving downtown and a policy goal for the City. Although not as severe as in other cities, it is important for Fargo to incentivize affordable/attainable/workforce housing to head off a housing crisis. Downtown housing programs should focus on dense multifamily projects to maximum housing buildout as well. Along with providing support to housing projects, the Renaissance Zone has been able to turn the course of Fargo's commercial and entertainment downtown. TischlerBise has not found substantial evidence that the previous development would have occurred without the City's incentives nor substantial evidence that positive redevelopment will occur without City incentives.

- Furthermore, the development proposal "but for" tests are being conducted by a third party and as along as the third party has no interest in the proposal the City should continue this policy.

- With that said, TischlerBise recommends adjusting the maximum length of City incentive programs. As highlighted by leading researchers, a typical business is more concerned with short-term profitability and plans operations around a short-term forecast. While a long-term incentive package (i.e., 15-20 years) is providing a subsidy to a development project which has proven to be successful. TischlerBise did not examine specific past incentive packages, but ultimately, shorter timeframes will benefit the City's bottom line. However, since the nature of development varies, maximums should be based on the type of project. For example, job creation projects could be limited to ten years, while on the other hand, if there is a project that addresses other community goals that require long term incentives to be successful (i.e., affordable housing) extending maximums would be justified.

- Furthermore, TischlerBise recommends the City include a requirement that eligible candidates for the Renaissance Zone and other programs be targeted industries which have high multiplier effects (i.e., generate a high number of spin-off jobs) and/or generate a high level of retail sales. In both cases, the targeted industry will generate additional revenue to the City which will help offset the incentive package. In some cases, the additional revenue, especially through new retail sales tax, will completely offset the incentive package and the development will be an immediate net positive to the City's bottom line. Such requirements could be implemented with the economic impact model that is being programmed by TischlerBise and will be presented to City Commission following this white paper.

- TischlerBise recommends that the City removes the 2-year new residential construction exemption. Although there is a slight benefit to residents, the lesser property tax (only the City's portion) is overshadowed by the overall housing cost and mortgage for a new home; thus, the exemption is most likely not an important element in the buyer's considerations. Fargo would be the first city in the metro area to remove this exemption. However, the City is already supporting new residential construction through its financing of subdivision infrastructure, so removing the 2-year property tax exemption on new housing would not alter the perception of City priorities.

- TischlerBise recommends furthering the City's focus on job training and business services. Proven through academic research and case studies, a locality providing business services to small to medium size businesses lowers obstacles for the business while being a relative low-cost program to the locality. Fargo is already supporting entrepreneurs and small businesses through the regional economic development organization and business events. However, the City could further its policies by tackling the issues businesses are facing post the covid-19 pandemic. For example, the City could invest in a job training and employment intermediary office to support local businesses looking to hire and expand.

- The City of Fargo should continue to monitor the need for parking downtown. An important factor in the past growth downtown was new parking structures and before the covid-19 pandemic parking was reaching capacity. Although, at least in the short-term, employment trends may favor

remote working, the downtown continues to expand its full-time residential population and commercial attraction. Development of parking structures requires long-term planning so the City should continue its strategic planning and explore any opportunities that would bring more parking to the downtown.

- Developing river boardwalks and parks has been successful for many communities across the country. Waterfronts present a natural asset to cities which can bring cultural, recreation, and entertainment benefits to its residents. Additionally, Fargo has an untapped commercial and economic resources in the Red River. Although there has been tremendous development when a city capitalizes its waterfront, there is a need for substantial funding to mitigate environmental issues and construct infrastructure. While there are flooding concerns and a mitigation program is being currently examined, TischlerBise recommends that Fargo explores in detail the economic potential of the Red River. There are a number of different limitations such as land capacity and funding availability (i.e., regional, state, and federal) that need to be understood, but there could very well be cooperation between the flood mitigation initiative and economic development. For example, coordination with the City of Moorhead could amplifying efforts.

- This year the Cass Clay Community Land Trust is anticipating adding the first homes to its portfolio. This is the only land trust in the Fargo area and aims to support affordable housing by providing the land and other financial support to eligible homeowners. Land trusts generally target areas that have a history of disinvestment and have deteriorating or vacant lots. TischlerBise recommends that the City of Fargo take a proactive role in the land trust, or develop its own, to address blighting areas and support its Core Neighborhoods. If strategically planned, leveraging publicly held, developable land can be a particularly low-risk program for blighted neighborhoods since the land trust keeps ownership of a stable, or in some cases appreciating asset, and can set standards for redevelopment.

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Erik R. Johnson
City of Fargo
Assistant City Attorney

(21)

February 17, 2022

Board of City Commissioners
City Hall
225 4th Street North
Fargo, ND 58102

RE: Proposed ordinance repealing Section 2-0106 (term limits) and proposed resolution proposing new term limits ordinance to be submitted for city-wide vote

Dear Commissioners,

Enclosed for your consideration and for receipt and filing are (a) an ordinance repealing the existing term limits ordinance and (b) a resolution that will place a new term limits ordinance on the ballot for the June 14, 2022, city election.

Please note that the effective date of the repealing ordinance is designed to make the repeal of the old law mesh with the proposed new law. Your repeal of the old term limits law will take effect immediately prior to the effective date of the new term limits law (assuming the new law is approved by the voters). More precisely, the proposed new term limits ordinance, if approved by the voters, will take effect ten days following certification of the election results by the canvassing board and repeal of the old law will take effect at the end of the ninth day following the same certification of the election results by the canvassing board.

It was my intention in drafting the resolution containing the new term limits law that the new law closely match the wording of the law being repealed with the wording only modified as was needed to clarify the ordinance, so that it will be consistent with the November 2021 Order from the Cass County District Court interpreting the ordinance. You will also note that the proposed new ordinance is intended to be applicable to seated city commission members—described as commission members "...holding office at any time during the period of January 1st through July 1st, 2022."

Both the repealing ordinance and the resolution are submitted to you for receipt and filing only. The ordinance should be placed on the next regular city commission meeting for first reading, with the intention that second reading and final passage occur at the March 21st, 2022, regular city commission meeting. The resolution should be considered for approval once the repealing ordinance has received final passage. (It wouldn't make sense to propose a new term limits law if the City Commission were not to repeal the existing law.)

SUGGESTED MOTION NO. 1 (Repealing Ord): I move to receive and file An Ordinance Repealing Section 2-0106 of Article 2-01 of Chapter 2 of the Fargo Municipal Code Relating to Term Limits for City Commission Members and to place the ordinance on the next regular city commission meeting for first reading.

SUGGESTED MOTION NO. 2 (Resolution): I move to receive and file the Resolution proposing a term limits ordinance to be placed before the city voters at the June 2022 election and that this resolution be placed on the agenda at the same meeting at which the City Commission is to consider the ordinance repealing Section 2-0106 for second reading and final passage.

Sincerely,

Erik R. Johnson

Erik R. Johnson
Assistant City Attorney

E.R.J.

Enclosures

OFFICE OF THE CITY ATTORNEY
FARGO, NORTH DAKOTA

ORDINANCE NO. _____

AN ORDINANCE REPEALING SECTION 2-0106 OF ARTICLE 2-01 OF CHAPTER 2 OF THE FARGO MUNICIPAL CODE RELATING TO TERM LIMITS FOR CITY COMMISSION MEMBERS

WHEREAS, the Board of City Commissioners desires to place the question of city commission term limits before the city electorate at the June 14, 2022, city election; and,

WHEREAS, the Board of City Commissioners deems it necessary and appropriate to repeal the City's existing term limits ordinance, Section 2-0106 of the Fargo Municipal Code, so that the city electorate is then allowed to vote whether or not to approve a proposed term limits ordinance; and,

WHEREAS, it is further the desire of the Board of City Commissioners that the proposed new term limits ordinance to be voted upon by the city electorate is to apply to existing, seated members of the Board and, therefore, that said repeal take effect immediately prior to the date that the proposed new term limits ordinance will take effect, without any interruption in the succession of terms of any of the existing, seated members; and,

WHEREAS, according to Section 1-0210 of the Fargo Municipal Code, the City's procedure for passing ordinances by city electorate, if there are a majority of "yes" votes of those members of the city electorate voting on the matter, the new term limits ordinance shall become effective ten days after the election results are certified, and, therefore, it is the desire of the Board of City Commissioners that this repeal become effective immediately prior to the tenth day after the election results are certified;

NOW, THEREFORE,

Be It Ordained by the Board of City Commissioners of the City of Fargo:

Section 1. Repeal.

Section 2-0106 of Article 2-01 of Chapter 2 of the Fargo Municipal Code is hereby repealed in its entirety.

OFFICE OF THE CITY ATTORNEY
FARGO, NORTH DAKOTA

ORDINANCE NO. _____

Section 2. Effective Date. This ordinance shall be in full force and effect upon the expiration of the ninth day after the results of the June 2022 city election are certified.

_____
Timothy J. Mahoney, M.D., Mayor

Attest:

_____
Steven Sprague, City Auditor

First Reading:
Second Reading:
Final Passage:

COMMISSIONER _____ introduced the following resolution and moved its adoption:

RESOLUTION

WHEREAS, Fargo Municipal Code Section 1-0210 authorizes the board of city commissioners to submit proposals for enactment of an ordinance to the city voters; and

WHEREAS, the board of city commissioners finds it desirable and appropriate to propose for city-wide vote an ordinance establishing certain limitations on the number of consecutive terms in office that a member of the city commission may serve; and,

WHEREAS, an existing city ordinance establishing term limits having been repealed by the board of city commissioners;

NOW, THEREFORE, BE IT RESOLVED that an ordinance establishing term limits for members of the city commission be proposed to the voters as follows:

Section 1. Enactment.

2-0106. Limitation on terms.--No member of the board of city commissioners may serve more than three (3) successive four-year terms; provided, that such term limitation shall be subject to the following:

A. Any member elected to a term of less than four years as a result of a vacancy on the board shall be eligible to serve three additional four-year terms and any such partial term or terms shall not be deemed to interrupt a succession of four-year terms.

B. Any member who has completed three successive four-year terms shall not be eligible for reelection until the next regular election following the expiration of such member's third successive term.

C. Any member who has served in the capacity of mayor, as well as city commissioner, may not serve more than four (4) successive four-year terms.

Section 2. Effect on Seated Members of City Commission.

In addition to being applicable to future members of the board of city commissioners, this ordinance shall also be applicable to any members of the board of city commissioners holding office at any time during the period of January 1st through July 1st, 2022.

Section 3. Effective Date.

This ordinance shall become effective ten days after the election results have been certified.

BE IT FURTHER RESOLVED that said proposed amendment be placed before the voters at the city election to be held June 14, 2022.

_____
Mayor

Attest:

_____
City Auditor

The motion for the adoption of the foregoing resolution was duly seconded by COMMISSIONER _____, and upon roll call vote, the following voted in favor thereof: COMMISSIONERS _____.
The following were absent and not voting: _____,
and the following voted against the same: _____,
whereupon the resolution was declared duly passed and adopted.

CERTIFICATE

STATE OF NORTH DAKOTA)
) ss.
COUNTY OF CASS)

I, Steven Sprague, the duly appointed City Auditor of the City of Fargo, North Dakota, do hereby certify that attached hereto is a full, true, and correct copy of the Resolution adopted by the governing body of the City of Fargo at the meeting held on Monday, _____ ___, 2022, and that such Resolution is now a part of the permanent records of the City of Fargo, North Dakota, as such records are filed in the office of the City Auditor.

Dated this _____ day of _____, 2022.

_____
City Auditor

(S E A L)

22

Good evening and thank you for letting my words be heard tonight – I wish I could be there in person. I am Daniel Stanislowski and I hold a PhD in Molecular Biology and Biochemistry. I am the Chief Science Officer of the Midwest Public Health Coalition, a public information and Action Company that investigates, analyzes and ultimately provides science-based information about issues of public health concern - to the public. As Covid-19 has been the public health concern d'jour for the better part of two years, I have studied all aspects of it in great detail and am writing this to you now to provide perspective on it.

It is incredibly rare for a child to die from Covid. According to the CDC, since the beginning of the pandemic, 795 children between the ages of 0 and 17 have unfortunately died WITH Covid out of a population of 73 million in this country. That is WITH Covid. Of these, 223 died with Covid and pneumonia rendering it more likely that these poor children died FROM Covid, though severe comorbidities are the likely cause of death in these instances as well.

The method of Covid case diagnosis involves the RT-PCR test which draws the viral RNA genetic material out of the swab sample, converts it to DNA, and doubles the amount of genetic material with each cycle of the PCR process. I have read the manuals from the test kits used in our wonderful state, and they use a cycle value of over 40. The CDC recommends 40 cycles. After doubling the starting material 30 times, you are left with approximately 1 billion times the amount of starting genetic material, and 1 trillion times after 40 cycles. Studies have demonstrated that the majority of viral samples are not viable from patients who test positive by PCR at over thirty cycles, and they become less and less viable with cycle beyond thirty. This means a large number of cases diagnosed as Covid are actually false positives. And the small number of children who died with Covid shrinks even further, as they were misdiagnosed.

Therefore, masking children does nothing to protect them as they are already safe. The flu is more dangerous to children than Covid and in the past masking children was never considered. While there are a few studies that show face masking stops the spread of respiratory viral illness, there are even more that demonstrate masking does not stop the spread of such illnesses. But because there is contradictory information, first principles must be considered. Covid is primarily spread through exhaled aerosols. One exhales countless aerosols with each breath. Studies on influenza have demonstrated that a single aerosol can hold thousands of influenza viral particles, in fact, one aerosol can hold enough viral particles to sicken a human, and a Covid variant is smaller than an influenza variant. Exhaled aerosols are small enough to penetrate even N95 masks and go above, below, and around all masks. Exhaled aerosols can remain airborne for many hours. One who is extruding virus is exhaling a great many viral-laden aerosols with each breath. It is physically impossible for a face mask to stop the transmission of aerosolized respiratory viruses. Moreover, masking alters blood oxygen and carbon dioxide concentrations which can have a profound harmful effect on health, yet no study has been conducted on the detrimental effects masking may have on human health. Nonetheless, the assumption was made that masking was "safe and effective". These last two years alone have disproven these assumptions.

I urge you to consider these facts with intellectual honesty and emotional disinterestedness. Masks did not work the first time, they will not work this time and they will not work any subsequent times. Masks do much more harm than good, particularly to children. Thank you for your time.

February 16, 2022
Fargo City Commission
Re: Negative implications of mask wearing in children

My name is Dr. Jake Schmitz. I have been a practicing chiropractor for more than a decade and have practices in both Fargo and Grand Forks communities. From the beginning of the "pandemic" I have been very vocal against the forced use of masks for children. Many issues with this policy come to mind. One of the main issues is the complete disregard for parents and their rights to choose medical treatment for their own children.

1. No good study can confirm masking has ANY impact on spread and prevention of SARS-CoV2. At best, biased observational studies or studies using other viruses (influenza, rhinoviruses, etc.) are used to prove efficacy, which is counterintuitive to the scientific method. Confounding factors get ignored in these "studies" which makes them null and void.

2. A simple comparison of school districts bears this out. West Fargo and Fargo school districts took different approaches, Fargo choosing mandatory masking for everyone, West Fargo choosing to make it optional. The case differences were negligible. This demonstrates how ineffectual masking is when done on a grand scale. FCPH was wrong to take the stance of mandatory masking for children.

3. The concept that masks do no harm to children is wrong. I am attaching two studies that illustrate masks (especially cloth masks) have an increased bacterial burden, with many strains being antibiotic resistant. The microbiome (probiotic) of the nose and mouth were altered after 4hrs of mask wearing in the participants of the study. The implications of this are profound, and we have only begun to understand how important the microbiota is for human health. To say, unequivocally, that masks are safe and effective would be laughable if it wasn't so damaging to our children's health.

4. Here is a list of known negative side effects of mask wearing: sinusitis, increased acne, itching and skin irritation, headaches, breathing difficulties, decreased O2, increased CO2, increased anxiety and stress, mask mouth (gingivitis, halitosis, candidiasis and cheilitis), and a higher prevalence for mouth breathing, which brings its own negative consequences.

5. Known pathogens on masks when not properly sanitized daily: E. coli, Staphylococcus aureus, Candida, Klebsiella, Enterococci, Pseudomonads, Enterobacter and Micrococcus, most of which are harmful to human health. One study found that upwards of 38.5% of the bacteria isolated from the masks in the study contained antibiotic-resistant strains. This could lead (and I would argue, has) to a serious health challenge for children.

FCPH had a moral and ethical responsibility to host lectures and/or classes for parents on adequately cleaning/caring for masks. To not teach parents how to correctly apply and clean the masks their children were wearing is account to malpractice, and any adverse health ramifications need to be laid at your feet!

With these facts, all supported by peer reviewed scientific literature, any doctor taking a position that mandatory mask wearing is safe and effective without acknowledging the negative effects is

either willfully ignorant or intentionally ignoring the data. I am attaching the studies used for this letter. FCPH essentially stripped parents of their right to make decisions for their children. In no way is this acceptable and our health officer (Dr. Newman) consistently went to the school board to vote on policy she created. That is a conflict of interest, and she should have recused herself from the vote. By her not making clear her role in creating the mask mandate, she has lost trust in her ability to function in either her role as a school board member or as the health officer for FCPH.

If you have any questions, I am open to discuss this issue, as I feel it is extremely important moving forward. As it pertains to the Covid Pandemic, masks should **NEVER** be mandated and the scientific community (PhD researchers) agrees.

Maximum Blessings,

Dr. Jake Schmitz, DC, MS, DCN candidate

Use of surgical face masks to reduce the incidence of the common cold among health care workers in Japan: A randomized controlled trial

Joshua L. Jacobs, MD,[a,b] Sachiko Ohde, EdM,[b] Osamu Takahashi, MD, MPH,[b,c] Yasuharu Tokuda, MD, MPH,[b,c] Fumio Omata, MD, MPH,[b,c] and Tsuguya Fukui, MD, MPH[b,c]
Honolulu, Hawaii, and Tokyo, Japan

Background: Health care workers outside surgical suites in Asia use surgical-type face masks commonly. Prevention of upper respiratory infection is one reason given, although evidence of effectiveness is lacking.

Methods: Health care workers in a tertiary care hospital in Japan were randomized into 2 groups: 1 that wore face masks and 1 that did not. They provided information about demographics, health habits, and quality of life. Participants recorded symptoms daily for 77 consecutive days, starting in January 2008. Presence of a cold was determined based on a previously validated measure of self-reported symptoms. The number of colds between groups was compared, as were risk factors for experiencing cold symptoms.

Results: Thirty-two health care workers completed the study, resulting in 2464 subject days. There were 2 colds during this time period, 1 in each group. Of the 8 symptoms recorded daily, subjects in the mask group were significantly more likely to experience headache during the study period ($P < .05$). Subjects living with children were more likely to have high cold severity scores over the course of the study.

Conclusion: Face mask use in health care workers has not been demonstrated to provide benefit in terms of cold symptoms or getting colds. A larger study is needed to definitively establish noninferiority of no mask use

(Am J Infect Control 2009;37:417-9.)

In 1973, a letter to the editor appeared in a prominent medical journal from Jack Resnick, MD, suggested "... perhaps the ancient oriental custom of wearing gauze or cloth, surgical-type masks during a cold has some merit? Perhaps Western society has another lesson to learn by observing the oriental customs besides acupuncture." He suggested this matter be studied in a rigorous manner.[1]

Since then, there has been limited study directed at addressing Dr. Resnick's implied question: does wearing a surgical mask protect from the common cold? A meta-analysis of the published literature reveals that conclusive evidence is not available.[2] Despite this, the practice of wearing a face mask seems to be commonplace in Japan and elsewhere. It is time to heed Dr. Resnick's call.

Reasons given for face mask use are many and include decreasing risk of upper respiratory infection (URI; or cold).[3] In Japanese cities and other densely populated areas in Asia, crowding on public transport can be extreme.[4] In these situations, taking measures to limit respiratory droplet spread to minimize the risk of URI has strong face validity, although definitive evidence for its effectiveness is lacking.

Health care workers are at particular risk of exposure to and acquisition of URI.[5] In light of the common use of face masks to limit spread of URI, the present study was undertaken to investigate the superiority of face mask over no mask use in preventing this clinical outcome.

METHODS

The study was a 77-day prospective randomized controlled trial beginning in January 2008. Subjects were recruited from a population of health care providers at a 520-bed tertiary care hospital in Tokyo, Japan. Exclusion criteria were self-identification of conditions predisposing to URI or taking antibiotics. Participants were given ¥9000 (approximately 90 US dollars equivalent) each. All underwent informed consent. The hospital ethics board approved the study.

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Mask and no mask groups were formed using block randomization of subjects within their respective job categories: nurses, doctors, and comedical personnel. Those in the mask group wore a face mask while on hospital property serving in their role as a health care worker. The hospital-standard disposable surgical mask MA-3 (Ozu Sangyo, Tokyo, Japan) was used. Subjects in the no mask group refrained from wearing a face mask while on hospital property unless required to do so as part of their job duties (eg, surgical nurse in the operating room).

An intake survey was administered to measure demographic data, health information, and quality of life. Each subject kept a daily health diary to record any of 8 symptoms of URI on a 4-point scale (0, none; 1, mild; 2, moderate; 3, severe; for fever: 0, absent; 1, present). Criterion for URI was a 2-day total symptom score greater than 14 (modified Jackson criteria[6]).

Fisher exact test was used to measure the difference between groups for URI. Student *t* tests were used for frequency of symptoms. Univariate analyses were performed to differentiate subjects with total Jackson scores below the median and those at or above the median. Factors analyzed were subject group assignment and those differentiating items on the intake survey. All analyses were conducted using SPSS version 15 J (SPSS Japan Co, Tokyo, Japan). A *P* value of less than .05 was considered significant.

RESULTS

Thirty-three volunteers met inclusion criteria. One subject in the no mask group dropped out after 1 week of data collection. Intake survey questions' results and subject demographics are summarized in Table 1.

One participant in each group had a Jackson-verified URI (not significant). Analyses were performed following the principles of intention-to-treat. The mean (standard deviation [SD]) Jackson score over the length of the study was 43.3 (SD, 47.7), the range was 0 to 210, and the median was 28.5. As shown in Table 2, the likelihood of having a higher total Jackson score was significant only for the factor of having children in the household.

Compliance with mask use and nonuse was good, with most (84.3% of subjects) self-reporting full compliance (remainder complying 79.2%-98.7% of the time). Table 3 shows the number of days of the different symptoms among all participants with cold symptoms (98% of subjects). Subjects in the mask group were significantly more likely to experience more days of the symptom "headache" and had a trend to experience more days of the symptom "feel bad." There were no significant differences between the 2 groups for symptom severity scores.

Table 1. Demographic and subject characteristics of mask (n = 17) and no mask (n = 15) groups

	Mask group	No mask group
Male (%)	5 (29)	4 (25)
Age in years (SD)	35 (14)	36 (9.6)
No. of MDs (%)	4 (24)	3 (19)
No. of RNs (%)	7 (41)	5 (31)
No. of comedical personnel (%)	5 (29)	6 (38)
No. of Administative staff (%)	1 (6)	2 (13)
Influenza vaccine (%)	17 (100)	13 (81)
Pneumonia vaccine (%)	1 (6)	0 (0)
Sleeping hours (SD)	6.2 (1)	6.2 (1.2)
Commute by train or bus (%)	10 (59)	11 (69)
No. with children in household (SD)	0.35 (0.7)	0.67 (0.9)
PCS8 (SD)	53 (3.8)	52 (4.9)
MCS8 (SD)	48 (4.7)	49 (4.6)

PCS, physical component score of Short-Form 8; *MCS*, mental component score of Short-Form 8.

Table 2. Univariate analysis of factors associated with subjects having Jackson score totals over the course of the study below the median of 28.5 versus at or above the median

	Below median group	At or above median group	*P* value
Sex, male, n (%)	5 (31.3)	4 (25.0)	.69
Mean age, yr (SD)	34.6 (9.1)	37.2 (14.6)	.55
Mask group, n (%)	6 (37.5)	9 (56.3)	.29
Clinicians, n (%)	8 (50.0)	10 (62.5)	.72
Living with children under 16 years old, n (%)	2 (12.0)	8 (53.3)	.02*
Use public transportation everyday, n (%)	9 (56.3)	11 (73.3)	.32
Flu vaccine, n (%)	15 (93.8)	14 (87.5)	.54
Sleeping hours (SD)	6.2 (1.0)	6.3 (1.1)	.87
Daily gargling, n (%)	10 (62.5)	10 (62.5)	1.00
PCS8, mean (SD)	53.5 (4.1)	52.1 (3.8)	.33
MCS8, mean (SD)	48.3 (4.7)	48.7 (4.9)	.81

NOTE. Course of the study was 77 days.
PCS, physical component score of Short-Form 8; *MCS*, mental component score of Short-Form 8.
*$P < .05$.

DISCUSSION

The low number of participants in the study limits the interpretations of the results. However, the findings do not support the utility of surgical face masks in protecting health care workers in Japan from URI. There were significantly fewer people experiencing days with "headache" in the group that did not wear masks and a trend for this group to report fewer days with the symptom labeled "feel bad." This clearly does not suggest a protective effect of masks for common cold symptoms. Our findings confirm previous reports that experience of cold symptoms is likely associated with living with children.[7]

Table 3. Mean number of days of cold symptoms in the mask (n = 17) and no mask (n = 15) groups

Symptoms (average days)	Total		Mask group		Non-mask group		P value
	Mean	SD	Mean	SD	Mean	SD	
Any symptoms	15.1	13.7	16.1	13.6	14.2	14.1	.81
Sore throat	4.2	6.7	3.8	7.9	4.5	5.8	.25
Runny nose	8.0	10.8	8.9	11.9	7.2	10.0	.67
Stuffy nose	5.8	8.8	3.7	4.5	7.6	11.2	.46
Sneeze	4.6	6.6	4.5	6.6	4.7	6.8	.80
Cough	4.8	8.6	4.3	9.6	5.2	7.9	.45
Headache	3.0	4.5	4.9	5.5	1.3	2.5	.01*
Earache	0.4	0.8	0.5	0.7	0.3	0.8	.22
Feel bad	4.0	5.7	5.6	5.9	2.6	5.2	.06

*$P < .05$.

Used properly, the surgical face mask obscures the face from just below the eyes to the chin. Patients or coworkers cannot see most facial expressions of a person wearing a mask. This may have a deleterious effect on the social bond needed in health care settings because it obscures an important nonverbal mode of communication. Wearing a face mask may also communicate to the other party that the individual with the mask is either (1) infectious or (2) thinks the person they are talking with is infectious. Both assumptions serve to distance the individuals involved, possibly harming the therapeutic relationship.

There are several limitations of the study. Sample size was only large enough to detect an absolute risk reduction for URI of 60% for those in the mask group. Recruitment was difficult. E-mail blasts, oral presentations to groups, cafeteria sign-ups, newsletter announcements, monetary inducement, and personal appeals were not effective in getting widespread participation. Additional constraints follow. Subjects were from 1 hospital in Tokyo and used only 1 type of face mask. Subjects' face mask wearing was controlled only in the hospital. Behavior outside of the hospital was not measured nor was frequency of replacing face masks. These factors make generalizability difficult.

Although a larger randomized controlled trial is indicated, the widespread use of face masks in Japan renders recruitment highly problematic. Sociocultural values may prevent the highest levels of evidence from being accrued. The Japanese Ministry of Health, Labour, and Welfare cites the level of evidence for using face masks to prevent colds as IIIA, no evidence, strongly recommended.[8] If the mask offers no benefit, forgoing a mask will save money and lessen environmental impact, as well as allow health care workers to interact with each other and with their patients with the full facial expression and other nonverbal communication at their disposal. If there is benefit, then health care workers throughout the world should be encouraged to use face masks.

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On the Purported Efficacy and Safety of Face Mask Use to Stop Transmission of Covid-19

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INTRODUCTION

With increasing SARS-CoV-2 infection numbers across the globe, fear of a second wave of Covid-19 – the disease resulting from significant SARS-CoV-2 infection[1] – has produced yet another unique change in human behavior to attempt to combat this seemingly omnipresent threat: face mask usage. This subject has become the latest addition to the large pile of divisive subjects thrust into Western consciousness, furthering highly irrational public discourse. Unsurprisingly, individual opinion on the face mask issue coincides with the individual's political leaning[2], which is, of course, absurd. The truth of a matter is not subject to political affiliation. Despite this glaring reality, large swaths of lay persons, doctors, and scientists alike parrot with fervent devotion the latest television-intoned mantra of choice from the most appealing cult of personality of choice to whom they have surrendered their intellectual assent. This functional illiteracy manifests in the echoing of platitudes along the lines of, "I believe in science; therefore, I choose (insert desired action here)." Through application of one's intellect to the subject, one can avoid such dangers and transmute his or her blind faith in scientism into comprehension. But it is an unfortunate pox on our time that despite the superabundance of information in our world there is a corresponding scarcity of understanding. Indeed, one could say it is the superabundance of information itself that obfuscates understanding. At the same time, however, it exposes a major flaw in modern science: one can find literature to support opposing positions on a great many subjects. To overcome this obstacle and be able to discern the correct position on any subject, one must come to understand the underlying principles at play. It is the goal of this work to elucidate the important basic principles involved in face masking to halt SARS-CoV-2 transmission.

WHO TRANSMITS AND WHO IS SICKENED BY SARS-CoV-2?

If an individual must wear a face mask, it stands to reason that this individual must be capable of transmitting the virus. Within our current face mask-mandate climate, the assumption is that anyone at any time is capable of this; anyone at any time is merely asymptomatic and thus everyone must wear a face mask. Before continuing it is important to differentiate between a- and presymptomatic individuals. The words themselves offer a superficial understanding: asymptomatic individuals are without symptoms and will not develop them – will not get sick, and presymptomatic individuals are temporarily without symptoms but will eventually develop them – will eventually get sick. Next, one must understand that there is a distinct biological difference between a- and presymptomatic individuals. The asymptomatic individual exhibits a robust immune system response while the presymptomatic's flounders. The former has some immunological disposition which renders him/her capable of fighting off either a great many pathogens in general or SARS-CoV-2 in particular, and the latter lacks this capability. Yes, the presymptomatic was at one time asymptomatic, and while the difference between the two may be imperceptible to the human eye before the presymptomatic turns symptomatic, the invisible immunological difference exists. The distinction between the two cannot be made using the prevailing

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reverse transcription polymerase chain reaction (RT-PCR) detection methods[3]; indeed, the distinction between virulent and obliterated virus cannot be made by this method. RT-PCR detects minute fragments of viral RNA which must be amplified by orders of magnitude before its presence can be confirmed. Because the detected RNA fragment can derive from actively replicating viruses and destroyed viruses alike, a positive RT-PCR result alone is not evidence of an active infection. It is a distinct possibility, therefore, that asymptomatic individuals are testing positive for SARS-CoV-2 RNA and a conquered infection and thus are not spreading virions. It is possible that this is the case for a great many, if not all, asymptomatic individuals. This highly plausible scenario has been hitherto unexamined with scientific rigor despite the urgent need for it.

Early in the life of Covid-19, several reports were rapidly published detailing evidence of SARS-CoV-2 human-to-human transmission[4,5] and infection in a- and presymptomatic individuals[6–12]. Subsequent studies interrogated the potentiality of SARS-CoV-2 transmission from individuals displaying no symptoms with quick, small cohort analyses which were rapid-fired into public consciousness[13–22]. Of the studies which claim to provide evidence of SARS-CoV-2 transmission from asymptomatic carriers, Li et al[5], Zhang et al[14], Rothe et al[16], and Ye et al[21] have very limited cohort sizes (7, 5, 5, and 5 respectively) and mistakenly use the term asymptomatic when the appropriate term is presymptomatic. Li et al likewise had a small cohort (5) and detailed a supposed asymptomatic spreader, though this individual did not test positive for SARS-CoV-2 by RT-PCR until well after others in the cohort developed symptoms[19], the individual was assumed to be the spreader as he had traveled to Wuhan though the testing suggests he was infected by his family, not the other way around. Hu et al examined a somewhat larger cohort (24) and revealed 1 potential asymptomatic spreader[17]; however, this study suffered from a confounder which the others also share – the possibility of the infections coming from alternate, unknown sources cannot be eliminated[23]. A contract tracing study was recently performed to better address the question of SARS-CoV-2 transmission from a true asymptomatic[24]. This study traced an asymptomatic individual, positive for SARS-CoV-2 by RT-PCR, to 455 contacts and assessed these 455 for SARS-CoV-2. All contacts tested negative for the infection. The aforementioned inability of RT-PCR to distinguish between RNA from live and dead virus renders virologic evidence of asymptomatic transmission dubious[25–27], particularly in the case of an infant with high viral load who remained asymptomatic throughout hospitalization[28]. Moreover, all analyzed specimens collected from potential cases are extracted from oropharyngeal or nasopharyngeal swabs and not being actively extruded from them. The experiment required to prove asymptomatic transmission would involve isolating asymptomatic carriers with negative testers and assessment of the extent to which the virus infects the negative testers. This is, of course, a highly unethical experiment and will not be performed. There is no evidence to suggest SARS-CoV-2 spreads from asymptomatic infections, which is analogous to what is known about influenza[29].

A significant portion of the human population is already immune to Covid-19. Several examinations of antibodies against SARS-CoV-2 in populations have been conducted to determine the extent of SARS-CoV-2 spread[30–35]. These antibody studies have multiple problems: the lifetime of circulating antibodies against SARS-CoV-2 can wain within weeks[36], which appears to be different than the lifetime of IgG antibodies against the original severe acute respiratory syndrome-causing virus (SARS-CoV) which can persist for at least 12 years after infection[37], so infected individuals may be producing antibodies against SARS-CoV-2 antigens other than the antibody being tested for; despite a recent bioinformatic assessment of the antigenic dominance (85.3-90.9%) of the SARS-CoV-2 spike protein[38], actual antigen measurements from SARS-CoV-2 exposed individuals revealed only 27% T cell response to spike protein antigens, indicating T

cell reactivity to several other SARS-CoV-2 protein epitopes[39]; additionally, a preponderance of evidence from work on coronavirus outbreaks of recent memory, SARS and MERS, suggests immunity to these coronaviruses derives from $CD4^+$ and $CD8^+$ memory T cells[40–45], implying antibodies are not necessarily what confers immunity to coronaviruses and, therefore, serological antibody tests do not provide an accurate image of one's immune posture against SARS-CoV-2 infection. Congruent to the SARS and MERS literature, recent excellent work has demonstrated SARS-CoV-2-reactive T cell mechanisms to be invaluable to immunity to Covid-19[39,46–48]. These studies further revealed an intriguing discovery: healthy, SARS-CoV-2 unexposed individuals displayed T cell reactivity to SARS-CoV-2. Indeed, Grifoni et al[39] found $CD4^+$ T cells from 40-60% of blood donations from years previous to the SARS-CoV-2 pandemic to be reactive to SARS-CoV-2 antigens, Braun et al[47] discovered these cells in 34% of healthy donors, both likely from immunological cross-reactivity of coronaviruses responsible for the common cold and SARS-CoV-2, and Nelde et al[49] discovered these T-cell responses in 81% of unexposed individuals again citing heterologous immunity from exposure to circulating common cold coronaviruses. This makes perfect sense considering the large homology between common cold coronaviruses and SARS-CoV-2 protein amino acid sequences[50]. These findings indicate an existing immunity to Covid-19 and a relatively small leap to be made to achieve[51], or to have already achieved[52–54], the natural herd immunity threshold.

Those at risk of serious illness after SARS-CoV-2 infection are overwhelmingly of older age (65+) and/or possess comorbid health complications like hypertension, diabetes, cardiovascular disease, or respiratory diseases[55–58]. There is nothing to suggest that younger individuals in good health are more likely to succumb to the ravages of SARS-CoV-2 infection than any other virus which circles the globe every other year. A recent study, conducted in the pre-face mask era, revealed school aged children and their teachers had very low anti-SARS-CoV-2 IgG seroprevalence of 0.6%[59], even amongst 23 of 24 participants who live with a household member who previously tested positive for SARS-CoV-2, suggesting extremely low prevalence of the virus in this population. Further, studies have now found no child-to-child[60] or child-to-adult[61] transmission of SARS-CoV-2. This demonstrates that our youth are not in imminent danger, nor are their teachers, from SARS-CoV-2. Schools should no longer be closed; our youth are a bulwark against Covid-19. Indeed, school closure was ineffective at slowing the spread of this virus[62] as children and teachers do not significantly contribute to Covid-19 transmission[63].

CAN A FACE MASK STOP THE SPREAD OF COVID-19?

Though SARS-CoV-2 may infect the body through the fecal-oral route[64,65] and fomite contact[66,67], aerosol transmission appears to be the primary mechanism for its transmission[68,69]. From this follows the theory behind face mask use: blocking or slowing virus-laden airflow from an individual will protect his or her fellow citizens as well as serve to protect the individual form virus-laden airflow originating from his or her fellow citizens. However, like other superficial theories emanating from the biomedical world, this theory crumbles when examined with any diligence beyond trusting a perfunctory platitude from "experts" on the television. The face mask question has been considered for decades and has been assessed in diverse arenas by sundry paradigms. The actual science is unequivocal: face masks do nothing to stop the spread of any type of infection. Results from studies performed in operating rooms[70–74], amongst clusters of healthcare professionals[75–77], and in broader communities[78,79] all report the same finding: face masks afford no protection against bacterial and viral infection. Several literature reviews further support the inability of face masks to stop these pathogen classes[80–83] or highlight the lack of evidence to suggest they do[84–89]. The reason for a face mask's inability to stop viral transmission is, quite simply, it cannot physically contain virus-laden aerosol particulates.

Viruses can penetrate face masks of all classes. N95 respirators, which are designed to filter 95% of aerosolized contaminants, do not live up to their name when confronted with viral assault[90], and afford no superior protection against respiratory illness and viral infection compared to surgical masks[91,92] which, as just evidenced, does not protect one against viral infection. Regarding homemade cloth masks, one randomized trial[76] found them to actually increase the rate of influenza-like illness – cloth mask use during influenza season may be particularly dangerous. The filtering efficiency of cloth masks is, of course, material-dependent but is generally quite low[76,93,94] and, like all face mask classes, relies on proper use. Proper use is hit-or-miss, to say the least, as mask wearing causes a number of annoyances to its wearer[95], particularly skin irritation and damage[96,97]. A study of surgical masks by Oberg et al[98] revealed all subjects failed an unassisted mask fit test and all but two failed after assistance. This same study further examined filtering efficiencies of surgical masks and found no surgical mask to provide adequate filtration efficiency to be viable protection against respiratory infection[98]. This is because a large fraction of virus-containing aerosols is sub-micron in size[99]. Yang et al[100] assessed aerosol particulates of varying sizes for their influenza A genomic content and discovered 64% of influenza A genome copies were present in aerosols less than 2.5 microns in size. This implies virus-harboring aerosols come in sizes small enough to readily penetrate surgical masks, cloth masks, and n95 respirators alike[90,93,98]. These small aerosols can remain in the indoor air for hours after exhalation[100] and can contain 10^3 to 10^7 viruses[101]. The number of viruses needed to infect a tissue culture 50% of the time ($TCID_{50}$) is between 100 and 1000 and the human infective dose is estimated to be between 2 to 3 times $TCID_{50}$[102–104]. This implies one inhaled virus-laden aerosol harbors well beyond the minimum infective dose to sicken a human[105]. This alone renders face masks useless. Further, it needs to be understood that most of the air exchange between the environment and the mask-wearer's lungs will not occur through the mask but rather around it. One of the common inconveniences mask wearers experience is misting of glasses[95]. This phenomenon is caused by exhaled warm, moist air being deflected out above the mask and condensing on the glasses. This air likewise escapes below and out the sides of the mask. As the viral aerosols do not possess any face-mask homing mechanisms, the air escaping around the mask will carry viral-laden aerosols to the environment. The same principle applies to inhalation; if one is in an environment with aerosolized viral particles not only will these aerosols penetrate the face mask, but they will be readily inhaled around the face mask. Face masks protect neither the individual wearing it nor the others sharing the environment.

Early in the pandemic several nations, the Center for Disease Control, and the World Health Organization were recommending against the use of face masks by the general public for stopping the spread of SARS-CoV-2[106]. Despite the reality of mask science (see above), ignored recommendations against mask use to stem the Covid-19 tide[107,108], and estimations like that made by the Norwegian Institute of Public Health that 200,000 people would have to wear a face mask to stop one single infection[109], the latter pandemic months have seen face mask mandates appear in nations, corporations, and businesses across the globe. The "scientific rationale" provided for these mandates comes from studies like Zhang el al[69] which boldly claims face mask mandates alone saved thousands of lives in Italy and New York city yet bases its analyses on patently false assertions like face mask mandates being the only regulatory measure issued at the time[110]. In addition, the study is riddled with methodological shortcomings and has had its retraction from its journal called for by scientists across the globe[110]. Lyu et al[111] attempt to link state face mask mandates to lower daily Covid-19 cases between April 8 and May 15. This study fails to account for compliance in both mandate and non-mandate states and really should have collected data for some more months as, even in areas without mask mandates, face masking increased throughout the summer and so did SARS-CoV-2 infection counts in many states. Leung et al[112] assessed a face mask's capacity to inhibit viral

exhalation from coronavirus and influenza infected individuals but was unable to detect any exhaled, face mask or not, from the majority of participants and those which did shed virus, shed very little. The truth is face mask mandates fly in the face of real science. If these mandates were merely desperate, no-harm-no-foul, misguided attempts to stymy Covid-19 they could perhaps be forgivable; however, the reality is, once again, different than what it seems at first as mask wearing is certainly not harmless.

DOES A FACE MASK AFFECT THE HEALTH OF THE WEARER?

An aspect of mask wearing which is of paramount importance yet neglected by media and TV "experts" alike is the detrimental effects chronic mask wearing can have on the wearer. Though the main negative health outcome discussed in this section revolves around the induction of subnormal levels of blood oxygen, hypoxia, caused by wearing a face mask for an extended duration, it is certainly not the only detrimental effect masks inflict upon their wearers. If an individual is symptomatic, his or her face mask will retain some expelled virus which he or she can then re-inhale. Besides hampering the sick individual's attempt to aid his or her swamped immune system by reducing his or her viral load, the danger of inhalation of the virus from the face mask into the nasal passages increases the possibility of SARS-CoV-2 entering the brain by way of the olfactory nerves, a brain entry pathway utilized by other coronaviruses[113]. Glial cells and neurons express angiotensin converting enzyme 2[114], one of the SARS-CoV-2 receptor proteins[115], which the virus uses to enter these cells to produce the nervous system complications witnessed in some Covid-19 cases[116–118]. Mask wearing also reduces one's capacity to breathe through nasal passages after mask removal[119], reduces work rate performance[120], and significantly increases one's susceptibility to headaches[121,122], though this latter effect likely derives from hypoxia[123].

One of the more controversial aspects of face masking is whether it induces hypoxia. Virtually all "fact checking" websites deny hypoxia is caused by face mask wearing but cite no scientific publication and usually justify their position with a quote from one of those dubious "experts". Scientific examination of the relationship between face mask use and blood oxygen has demonstrated mask use to cause hypoxia. Beder et al[124] analyzed the blood oxygen saturation of surgeons after they completed their operations. This study revealed a time dependent effect on loss of hemoglobin oxygen saturation as longer surgery times (surgical mask wearing) were associated with greater oxygen deprivation, reaching statistical significance at 60-120 minute surgeries and further decreasing thereafter[124]. Johnson et al[125] probed face mask wearing and oxygen consumption by exercising individuals and found face mask-induced airway resistance caused maximum oxygen deficits to be reached more rapidly. There are no studies that demonstrate face masking has no effect on blood oxygen concentration.

Hypoxia produces many negative health outcomes: hypoxia causes activation of general inflammation[126]; it can induce liver inflammation[127] and injury[128,129]; it can produce mutation to mitochondrial DNA which damages mitochondrion function[130]; it promotes fibrosis of multiple tissues[131–133]; it contributes to a plethora of autoimmune disorders including rheumatoid arthritis[134–136], inflammatory bowel disease[137,138], psoriasis[139,140], and systemic sclerosis[141,142]; hypoxia engenders atherosclerosis[143–145]; it promotes glucose intolerance[146]; it can increase lipid synthesis to bring about hyperlipidemia[147,148]; it alters neuromuscular signaling and output[149,150]; hypoxia dysregulates neurotransmitter production[151]; it diminishes endothelial progenitor cell blood concentration, impairing the body's ability to heal internal injury[152]; it is carcinogenic as hypoxic microenvironments enhance tumor growth and metastasis[153–157]. But this is not all. The hypoxia pathology most germane to the current world situation is its modulation of the immune system.

Hypoxia triggers adaptation to both the innate and adaptive arms of the immune system. The important molecular immunobiological effect of decreased blood oxygen involves gene expression-controlling, oxygen sensing, and ubiquitously expressed proteins aptly named hypoxia inducible factors (HIFs)[158–161]. These proteins are associated with all the above-named hypoxic physiological maladies and direct macrophage and T cell function[162]. HIFs shift the metabolic status of immune cells in which they are expressed to an increased glycolytic (glucose breakdown for energy production) phenotype[160,163]. While this metabolic switch may increase the antimicrobial capacity of macrophages[164–166], HIF expression in macrophages brought on by chronic hypoxic microenvironments can contribute to inflammatory diseases[166,167] and increase tumor angiogenesis[168–170]. HIFs also influence T cell differentiation. HIFs drive T cell differentiation to the regulatory T cell (Treg) phenotype[171] which can contribute to autoimmune diseases[172]. Treg dominance suppresses $CD4^+$ T cell activity[173] which, as stated earlier, is the immunological mechanism present in large swaths of the population unexposed to SARS-CoV-2 which provide them immunity against Covid-19 antecedent to a SARS-CoV-2 infection. Thus, wearing a face covering actually blunts one's natural immunity to Covid-19 and ability to combat SARS-CoV-2 infection. If all this were not enough, there is more: face mask-induced hypoxia actually replicates aspects of SARS-CoV-2 infection. It was recently discovered that SARS-CoV-2 infected macrophages release large quantities of proinflammatory cytokines to cause T cell dysfunction and lung epithelia death – all by way of HIF biochemistry[174]. Not only is a face mask utterly useless in stopping the spread of SARS-Cov-2, it may actually encourage its pathology. It may encourage all the above-named pathologies. No study has been performed to assess the health outcomes of face masking, yet it has been foisted, with the assumption of safety and without informed consent, upon entire societies of people.

WHAT CAN ONE DO TO FIGHT SARS-CoV-2?

One is not helpless in the face of impending infection unless one chooses to be so. As opposed to the immune-suppressing action of face masking, one can engage in a variety of health-oriented behaviors which will support one's immune system. As simulated sunlight has been observed to reduce viral populations by 90% in 8 minutes[175], spending some time outside will help slow transmission as well as boost one's vitamin D levels. Vitamin D deficiency is associated with an increased risk of SARS-CoV-2 infection[176] and Covid-19 severity[177–180]; therefore, vitamin D supplementation has been suggested as a viable treatment for any stage of the viral infection[181–186]. Likewise, vitamin C is another ostensible treatment for Covid-19[187,188] and is being assessed to that end[189–191]. Vitamin A has been used in a regimen with other nutritional and oxidative therapies that has achieved a flawless success rate[192] (in an open-minded, scientific culture this method would see mass adoption). Vitamins A[193], C[194], and D[195] support multiple immune system biochemistries, and augmenting one's diet with these vitamins will help ward off all potential sickness-inducing pathogens, not just SARS-CoV-2. The same can be said for zinc[196,197] and selenium[198,199] which have also been proffered as weapons against SARS-CoV-2 infection[200]. One does not necessarily have to supplement these vitamins and minerals if one eats a diet rich in them[201]. It ought to be these foods one regularly consumes in addition to eschewing hyper-processed, sugar-dense fast foods which can scarcely be called food and which are a massive contributor to[202,203] the now perpetual obesity epidemic[204–206]. Obesity and its panoply of associated metabolic disorders induce immune system dysfunction and render one susceptible to infectious diseases[207], including Covid-19[208]. In like manner, the post-sugar consumption hyperglycemic state blunts the innate immune response[209] and increases the likelihood of SARS-CoV-2 infection taking hold[174]. True healthful behaviors will do lightyears more good for one's immune system and overall health than donning a face mask. If adopted by more and more

people, this improvement in individual health will morph into improved societal health, and healthy people and societies have no need to cower before health threats.

ON FREE CHOICE OF THE WILL

In the name of healthcare, preventative medical procedures are being forced upon the fearful, the ignorant, and the unwilling with near unanimous support of the "expert" class and with a complete absence of safety trials. Those with eyes to see recognize this is not the first time. The healthcare industry is, by very conservative estimates, the third leading cause of death in the United States of America[210,211]. Chronic illness is exploding[212], life expectancy is waning[213], and the last years of life have become a horror show of hospital visits, pharmaceuticals, and special care facilities. And where are the cures? One would expect the mountainous sums of money pumped into healthcare and biomedical research over the course of generations to have manufactured health improvement and longevity increases, yet the opposite is true. This only comes to be when the public "expert" class (doctors, scientists) is inculcated in myopic ignorance and applies its hyperspecialized knowledge sets to solve increasingly reductionist questions. When one reads headlines in the mold of, "Researchers discover (insert discovery here) and are closer to curing (insert disease here)," one ought to shake his or her head – our grandparents were reading the same drivel. Of course, not all doctors and scientists are substandard, but all doctors and scientists need to be challenged.

That which makes one human is the ability to reason. To discern. To will. To be able to choose other than what even the most seductive of stimuli would have one choose. Yet what we, as a people, have become is a species which has been trained to respond in formulaic manner according to that ever-immutable law of nature, monkey-see-monkey-do, to stimuli emitted from the powerful technological amalgamation of Pavlovian and Skinnerian thought: the television. Its dictates, we follow and its presentation of reality, we accept. All cogitation which originates from inspiration outside its purview is considered anathema. Even the most strident opposition to its false reality wilts before the psychic driving repetition, repetition... repetition. In his 1931 book, *The Scientific Outlook*[214], Bertrand Russell describes a future where entire societies will be unable to think outside of "expert" approved opinions. Though we are not yet there, we are moving, lock step, ever so dangerously close. In order to avoid falling into that abyss, one must resist falling prey to the scientifically designed and targeted circuses which flow from personal digital media devices, one must question experts, not concede to them without thought, and one must exercise intellectual freedom to discern truth.

Asymptomatic individuals are simply healthy individuals. They are not a "case" of anything, particularly if diagnosed using a worthless test[215], and are incapable of spreading SARS-CoV-2; they should absolutely not be required to wear a face mask. The face mask does nothing to stop viral transmission but does vitiate physical health. Healthy behavioral adaptation (which includes trashing the face mask) and habituation will benefit one far more than reliance on the medical establishment. And if the preponderance of evidence presented herein supporting these positions is unconvincing, that the health-destroying "expert" consensus opposes them ought to be.

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Original Article

Understanding the factors involved in determining the bioburdens of surgical masks

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Background: Surgical site infection (SSI) continues to be one of the most common postoperative complications. In our previous study, surgical mask (SM) bioburden was identified to be a potential source of SSI. In the present study, we investigated the factors involved in SM bioburden.

Methods: Bioburdens of the disposable SM (A: medical mask; B: medical surgical mask) and newly laundered cloth SM (C) were tested by immediately making an impression of the external surface of the mask on sterile culture media. SM microstructure was observed using a scanning electron microscope (SEM). Filtering efficiency and airflow resistance were evaluated with TSI Automated Filter Tester 8130 (TSI Incorporated) according to GB/19083-2010. Whether speaking during operation and washing the face pre-operatively affect SM bioburdens was also evaluated. Surgical procedures were performed in a dynamic operation room. Fifty cases of mask use were enrolled in this study.

Results: The bioburden of mask A was the highest. The bioburden of mask B was the lowest. Mask C possessed the lowest filtering efficiency and the highest airflow resistance. SM bioburden was higher in the speaking group. SM bioburden showed no significant difference after washing the face, despite the finding that washing could significantly reduce facial bioburden.

Conclusions: Multiple factors influence SM bioburdens. Mask B showed the lowest bioburden and best protection effects. Mask C is not recommended to be used, especially considering that surgeons do not wash the cloth masks daily. Unnecessary talking during operation is not recommended, and washing the face before surgery is not strictly necessary.

Keywords: Surgical mask (SM); bioburden; mask type; speaking; washing face

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Introduction

Surgical site infection (SSI) continues to be one of the most common postoperative complications; it is associated with significantly increased morbidity and mortality, prolonged hospital stays, and added costs, all of which cause substantial clinical and economic burdens (1-3). Determining effective strategies to prevent and/or control SSI is therefore vital.

Regarding SSI, airborne contamination and microbial shedding from personnel have been identified as the potential infectious sources (4). Effective ventilation strategies and

surgical attire have been applied in modern operating rooms to counter these. To some extent, reducing air-loaded contamination and microbial shedding during surgeries may help prevent/control SSIs (5-7). Therefore, surgeons are required to wear surgical attire during operations, including a surgical gown, sterile gloves, headgear, and masks, which together attempt to create a physical barrier between the surgeons and the patients (8). However, only the use of gloves and impervious surgical gowns has been found to reduce SSI. It was demonstrated that the use of masks and head coverings reduced contamination in operating rooms; however, the prevalence of SSI did not decline accordingly (8).

Surgical masks (SMs) were first developed in the early 20th century, after which they became the standard operating apparel and are now used routinely (9). It was observed that SMs significantly reduced the bacterial dispersal rates directly in front of the mouth (10), while other studies showed that the use of SMs failed to reduce the overall operating room bacterial counts (11). Over the past decades, whether SMs can decrease the rate of SSIs has been called into question since present research has been unable to identify the pronounced effect of SMs in reducing SSIs (12-14). However, current Occupational Safety and Health Administration (OSHA) regulations and universal precautions require face masks as part of personal protective equipment for scrubbed personnel (8).

In our previous study, we confirmed that the bioburden of SMs increase with prolonged wearing time, and SMs are a potential source of bacterial shedding, which may increase the risk of SSIs (15). Notably, in prolonged and complicated surgical procedures such as total joint arthroplasty (TJA), we observed that large amounts of blood and dust were produced when the pendulum saw was used to cut off bone, which splashed on the surface of SMs and rebounded to the operative field (15). Thus, strategies that could decrease SM bioburdens may help to decrease bacterial shedding from SMs, reducing SSI risk.

Therefore, in this study, we investigated multiple factors that could influence SM bioburdens, such as SM type, speaking during surgery, and face washing. We aimed to increase our understanding of SSI and provide some additional information regarding the use of SMs during surgeries.

Methods

Location, personnel, and study design

The study design was approved by the appropriate ethics review board. The study was performed in the operating room of cleanliness class 100 in a grade IIIA hospital in China. Mask samples were collected from orthopedic surgeons in TJA. The study team consisted of six surgeons, two students, and a microbiologist. The SMs were used in the surgical procedures of TJA. After the surgeries, the SMs were placed into sterile bags and submitted to the researcher. The periphery of the SMs was wiped off, and the surfaces of the SMs were then cut into an average of three parts, and an impression was made on the sterile agar plate (Tryptic Soy Agar Medium) on a clean bench and incubated for 48 hours in a humid aerobic atmosphere at 37 °C. The colony-forming units (CFUs) were then counted. In this experiment, a single blind was used, wherein the student did not know which group the SMs were from.

SM types

Three different types of masks were used in this study. Mask A is a type of medical mask with one filter screen. Mask B is another type of medical mask with two filter screens. Mask C is a reusable cloth mask, usually washed at intervals of several days. The microstructure of SMs was observed using a scanning electron microscope (SEM). The pore size and porosity were counted using Image J v1.8.0 (National Institutes of Health, Bethesda, MD, United States).

A TSI Automated Filter Tester 8130 (TSI Incorporated) was used to test the filter efficiency and airflow resistance according to PRC National Standard GB/19083-2010 (ICAS Certification & Testing Group, "Technical requirements for a protective face mask for medical use"). A 0.075 μm sodium chloride aerosol generated from salt water solution was used. Filter efficiency and airflow resistance were tested at an 85 L per minute airflow. The test was performed in two conditions: SMs underwent temperature pretreatment or no pretreatment. The condition of temperature pretreatment was that first SMs were placed in a test chamber at 70±3 °C for 24 hours and then at −30±3 °C for 24 hours.

Speaking and no speaking

We evaluated whether speaking can affect the bioburdens of SMs. Before surgical procedures, the surgeons washed their faces with sterile water, irrigated their nose with a sterile saline solution, and rinsed their mouth with medical mouthwash. Then, in the speaking group, the surgeons were required to recite step-by-step surgical procedures

during operation. In the non-speaking group, the surgeons were required to speak as few words as possible during the operation. After the surgeries, the SMs were collected, and an impression was made on the sterile agar plate for the following culture and bioburden analysis.

Face-washing or no face-washing

An additional factor investigated in this study was whether face cleanliness could influence SM bioburden. The surgeons washed their face before the process of surgeries with aseptic water for 10 seconds. The surgeons were required to speak as few words as possible during operation. After the surgeries, the SMs were collected, and an impression was made on the sterile agar plate for the following culture and bioburden analysis.

Statistical analysis

The results were expressed as the mean ± standard deviation. Statistical differences were analyzed using one-way analysis of variance. $P<0.05$ indicates a significant difference.

Results

Bioburdens of different types of SMs

Representative SEM images of SMs are depicted in *Figure 1*. Masks A, B, and C had a different pore size and porosity. Mask A possessed the highest pore size and porosity ($P<0.05$) (*Figure 1B,C*). Mask B possessed the lowest porosity ($P<0.05$) (*Figure 1B*). Filter efficiency and airflow resistance are depicted in *Figure 2*. Mask B possessed the highest filtering efficiency and lowest airflow resistance, which means mask B performed best in blocking airborne particles and provided the best air permeability, enabling the surgeons to breathe freely. On the contrary, mask C possessed the lowest filtering efficiency and highest airflow resistance, meaning it was the worst in blocking airborne particles and in air permeability, causing breathing difficulties in surgeons.

For performing the bioburden assay, bacterial contamination has been used as an adjunct measure of SSI, commonly measured using airborne or settled CFU counts (8). Thus, the number of CFUs from SMs was counted in this present study. Statistically, the number of CFUs from mask B was the lowest with significance, which indicated that mask B was the best in preventing bacterial shedding from personnel. The number of CFUs from mask A was highest, suggesting that mask A provided the poorest protection.

Overall, mask B provided the best protection and enabled surgeons to breathe smoothly; therefore, it should be highly recommended in surgery. Mask A performed worst in blocking bacterial shedding and should not be used in operating rooms. Regarding mask C, it had the highest air flow resistance, which might obstruct comfortable breathing in surgeons. Additionally, mask C could not block bacterial shedding as effectively as mask B. Notably, mask C was newly laundered, while in most cases, the surgeons did not wash their cloth masks every day.

Speaking and mask bioburdens

Bacterial shedding that could be restrained by the SM is mainly derived from the face skin and respiratory tract (8). Previous studies have demonstrated that fewer bacteria are expelled from the respiratory tract if the surgeon stays quiet and that avoiding speaking can decrease bacterial dispersion (16-19). However, some researchers hold different views and have shown that wearing masks during quiet breathing could lead to more bacterial shedding (20). Overall, whether speaking can influence bacterial shedding is still controversial. To the best of our knowledge, no previous study has identified whether speaking could influence mask bioburdens.

In this present study, we detected the mask bioburdens in both speaking and no-speaking situations. We demonstrated that CFUs from no-speaking masks were significantly lower than those from speaking masks ($P<0.05$) (*Figure 3*), indicating that unnecessary talking should be restricted in surgery.

Washing face and mask bioburdens

As the skin's surface is covered with bacteria, patients are encouraged to prophylactically decontaminate their skin before surgery, helping to reduce the risk of SSI. Specifically, washing the face has been recommended in preventing SSI in patients (21).

However, there is no previous study focusing on the relationship between SM bioburdens and face cleanliness. In this study, we examined the mask's bioburdens before and after washing the face. Washing the face resulted in significantly declined CFU numbers on the surgeon's face, but not in the masks (*Figure 4*).

Discussion

People often tend to skip steps in daily routines, even in

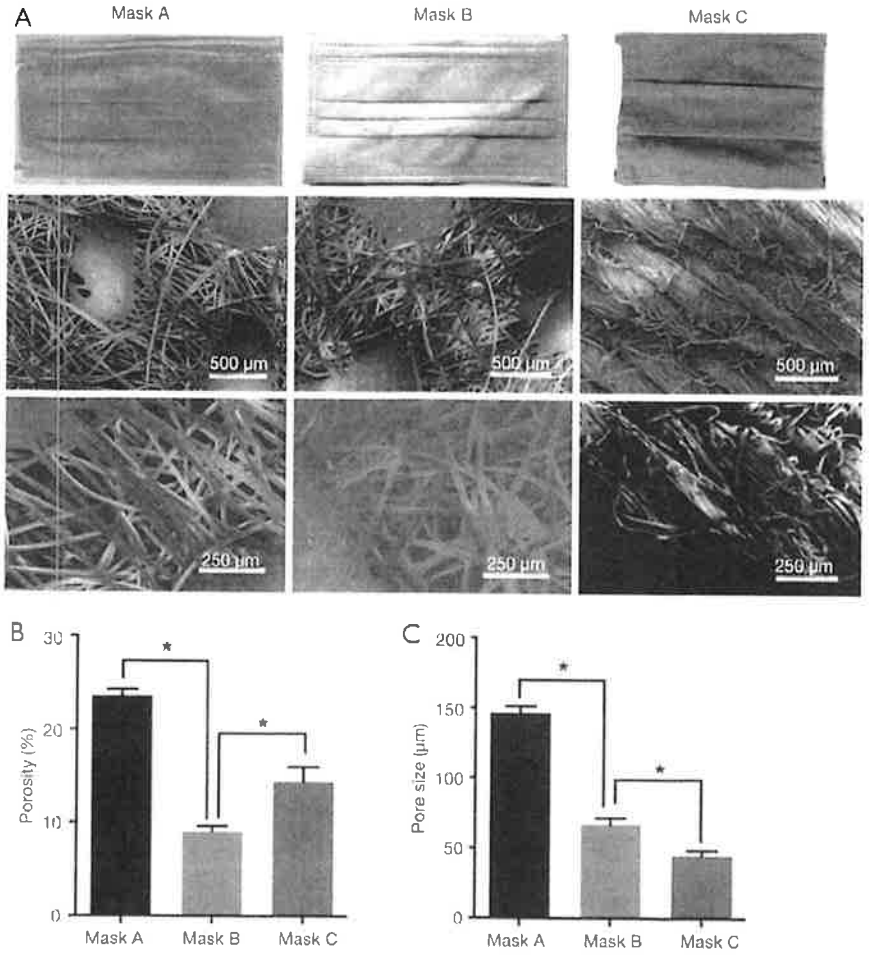

Figure 1 Different mask properties. (A) The scanning electron microscope of masks A, B, and C. (B) Mask porosity. (C) Mask pore size. *, P<0.05.

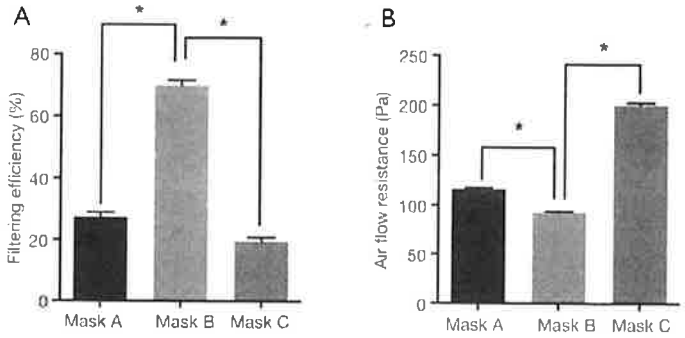

Figure 2 Mask filter efficiency (A) and airflow resistance (B). *, P<0.05.

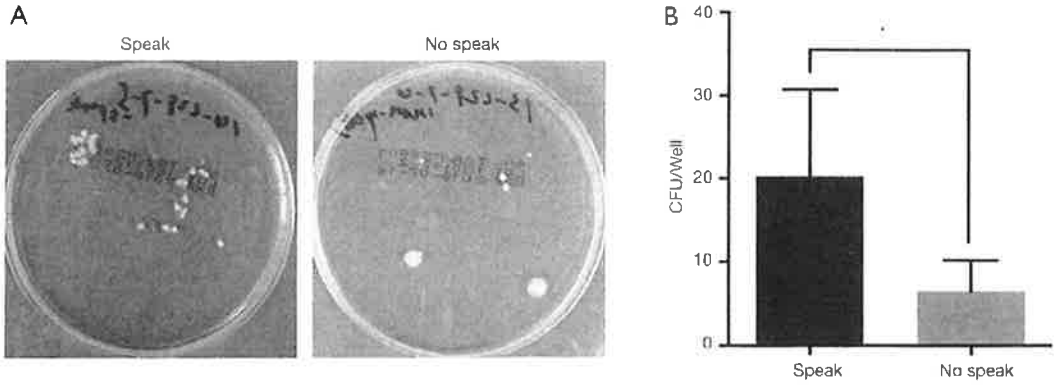

Figure 3 Representative CFUs of masks from speaking and no speaking (A), and statistical results (B). *, P<0.05. CFU, colony-forming unit.

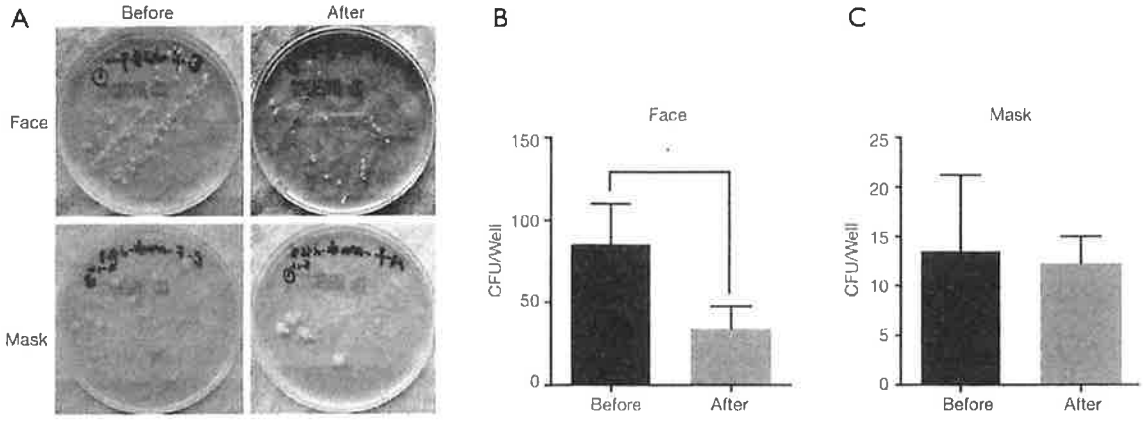

Figure 4 Representative CFUs of faces and masks from face-washing and no face-washing (A), and statistical results (B,C). *, P<0.05. CFU, colony-forming unit.

important fields such as surgery. In the operation room, surgical attire items are often neglected and may contribute to SSI occurrence (22,23). SMs have been standard operating apparel since the beginning of the 20th century, although their efficacy has always been controversial (8). There remains a significant lack of organizational consensus, even in today's highly infection-control conscious environment, as to how often the surgeon should change a new mask and which SM to select among the different types. In our previous study, we identified that masks with prolonged wearing time present a potential source of bacterial shedding and transmission of infection in surgery (15). At least in China, in most cases, a surgeon would wear the same SM for the entire day, sometimes wearing the same mask for several surgeries. Since the theory of aseptic technique is founded on the premise that a reduction in bacterial contamination will reduce the prevalence of SSI, identification of key influencing factors that may affect the bioburdens of SMs is of utmost importance and urgency. In this study, we investigated the factors that may influence the bioburdens of SMs and present some recommendations that may help decrease SSI incidence.

First, we evaluated the efficacy of different types of SMs in preventing microbial shedding from personnel. Different masks had diverse pore sizes and porosity (*Figure 1*). Mask B possessed the lowest porosity and moderate pore size, mask A had the largest porosity and pore size, while mask C had moderate porosity and the smallest pore size. We found no linear relation between porosity and pore size. Regarding filtering efficiency, which is associated with blocking bacterial shedding, mask B performed best in blocking airborne particles (*Figure 2*).

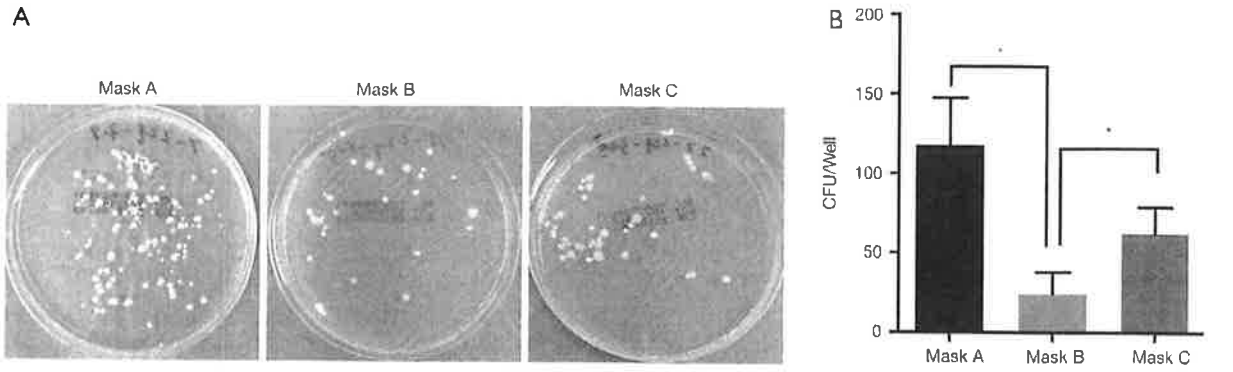

Figure 5 Representative CFUs of different masks (A) and statistical results (B). *, P<0.05. CFU, colony-forming unit.

Furthermore, in the bioburdens assay, mask B had the lowest CFU number, indicating that mask B performed best in restraining bacterial shedding from personnel (*Figure 5*). Mask A performed worst in blocking bacterial shedding. Concerning airflow resistance, which is associated with surgeons' breathing, mask B showed the best air permeability, allowing surgeons to breathe freely.

On the contrary, mask C showed the highest airflow resistance and the worst air permeability, which could cause the surgeons to have difficulty in breathing. Overall, mask B was found to perform best in protection and enabling surgeons to breathe; therefore, it should be recommended for use in surgery. Mask A performed worst in blocking bacterial shedding and should not be used in operating rooms. As mask C had the highest airflow resistance, the surgeons might not be able to breathe freely when using it. Also, mask C could not block bacterial shedding as effectively as mask B. Notably, mask C used in this study were newly laundered, while in most cases, surgeons do not wash their cloth masks daily.

Furthermore, we investigated the effect of speaking on the bioburdens of SMs. Previous studies have demonstrated that the respiratory tract is a source of bacterial shedding in the operation room (8), while fewer bacteria would be expelled from the respiratory tract if the surgeon remains quiet (16-19). However, whether speaking can influence mask bioburdens is not clear. In this present study, we demonstrated that the bioburden from the no-speaking masks was significantly lower than that from speaking masks (*Figure 3*), indicating that masks were beneficial in reducing bacterial counts during talking, which was in line with the results of the previous study (24). Therefore, unnecessary talking by surgeons should be restricted in surgery.

Another source of bacterial shedding in the operation room is the skin surface, and washing the face has been recommended to prevent SSI in patients (21). However, to the best of our knowledge, no previous study has identified the relationship between SM bioburden and the wearers' facial cleanliness. In this study, we showed that washing the face led to a significantly reduced CFU number on the surgeon's face, but the same was not true for the SMs (*Figure 4*).

There were certain limitations to this study. We have not investigated the relationship between the bioburdens of SMs and the incidence of SSIs. However, similar to the statement in our previous study, we performed this study based on the understanding that the theory of aseptic technique is founded on the premise that a reduction in bacterial contamination will reduce the prevalence of SSI. Moreover, as the saying goes: "Do not think any virtue trivial, and so neglect it; do not think any vice trivial, and so practice it" (15). Measures to control SSIs are of utmost importance and should be valued. We hope this present study can increase the knowledge about SSIs and focus more attention on their related risk factors. Future studies are warranted to identify the bacterial organisms that constitute the bioburden and potential clinical impact, if any, on the development of SSIs.

Conclusions

We determined that multiple factors are involved in the bioburdens of SMs, such as SMs types, speaking, and face cleanness. Based on the results of the present study, several conclusions can be drawn here: (I) mask type is a crucial factor that has a direct relationship with mask bioburdens; therefore, surgeons should be more prudent in selecting SMs. Masks with high filtering efficiency and low airflow resistance

should be recommended. (II) Speaking can increase the mask bioburdens; therefore, unnecessary speaking should be avoided in surgery. (III) Washing the face can reduce the bioburdens on the face, but not the mask.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study design was approved by the appropriate ethics review board.

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ORIGINAL RESEARCH
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Cotton and Surgical Face Masks in Community Settings: Bacterial Contamination and Face Mask Hygiene

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During the current COVID-19 pandemic, the use of face masks has become increasingly recommended and even mandatory in community settings. To evaluate the risk of bacterial cross-contamination, this study analyzed the bacterial bioburden of disposable surgical masks and homemade cotton masks, and surveyed the habits and face mask preferences of the Flemish population. Using culture approaches and 16S rRNA gene amplicon sequencing, we analyzed the microbial community on surgical and/or cotton face masks of 13 healthy volunteers after 4 h of wearing. Cotton and surgical masks contained on average 1.46×10^5 CFU/mask and 1.32×10^4 CFU/mask, respectively. *Bacillus*, *Staphylococcus*, and *Acinetobacter* spp. were mostly cultured from the masks and 43% of these isolates were resistant to ampicillin or erythromycin. Microbial profiling demonstrated a consistent difference between mask types. Cotton masks mainly contained *Roseomonas*, *Paracoccus*, and *Enhydrobacter* taxa and surgical masks *Streptococcus* and *Staphylococcus*. After 4 h of mask wearing, the microbiome of the anterior nares and the cheek showed a trend toward an altered beta-diversity. According to dedicated questions in the large-scale Corona survey of the University of Antwerp with almost 25,000 participants, only 21% of responders reported to clean their cotton face mask daily. Laboratory results indicated that the best

mask cleaning methods were boiling at 100°C, washing at 60°C with detergent or ironing with a steam iron. Taken together, this study suggests that a considerable number of bacteria, including pathobionts and antibiotic resistant bacteria, accumulate on surgical and even more on cotton face masks after use. Based on our results, face masks should be properly disposed of or sterilized after intensive use. Clear guidelines for the general population are crucial to reduce the bacteria-related biosafety risk of face masks, and measures such as physical distancing and increased ventilation should not be neglected when promoting face mask use.

Keywords: SARS-CoV-2, COVID-19, face masks, bacterial load, 16S rRNA gene amplicon sequencing, nasal and skin microbiome

INTRODUCTION

During the current coronavirus disease 2019 (COVID-19) pandemic, caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), the use of protective face masks has become increasingly recommended or even mandatory in community settings outside hospitals and care facilities (1, 2). Surgical or cotton masks are most often used to prevent respiratory droplet transmission and reduce transmission from people infected with respiratory viruses to non-infected people (3, 4). Due to some shortage in supply and concern about excessive waste of disposable masks, policy makers promote homemade non-medical (i.e., non-surgical) masks as personal protective equipment (PPE). As opposed to medical masks (e.g., surgical, medical procedure face masks, and respirators) that represent standardized personal equipment (PPE), non-medical masks are considered as not standardized and not intended for use in healthcare professionals (5). Although there are concerns that their filter efficacy is less able to block the transmission of viruses compared to surgical masks, this could be compensated by better adjustment to the face and less leakage (6). The efficacy of face masks against different airborne transmissions is best documented in controlled settings, such as use in hospitals by trained staff (7–9). Additionally, recent research has shown that they can also reduce COVID-19 transmission in other high-risk situations, such as hospitals (2, 10, 11). One meta-analysis and systematic review has concluded that the use of masks by healthcare workers and non-healthcare workers reduces the risk of respiratory virus transmission (including SARS, influenza virus, H1N1, and SARS-CoV-2) with 80 and 47%, respectively (2). However, this significant protective effect of face masks in community and health care settings was not found by other studies (1, 7, 12–17). Additionally, a recent randomized controlled trial study observed that wearing a face mask did not significantly reduce the SARS-CoV-2 infection rate in a community with modest infection rates (18). Since masks were not recommended public health measures most of the population did not wear face masks during this clinical trial. These results were also supported by another recent meta-analysis (19). In general, masks seem less effective in protecting the wearer from being infected (20), but they could reduce the risk of virus transmission when worn consistently (10, 21, 22).

The general assumption is that both medical and non-medical mask use is safe (23, 24), although this has not yet been monitored or studied in detail. Studies on mask efficacy [e.g., (25–27)] generally do not account for the fact that the microorganisms in human saliva and exhaled breath could form a biosafety concern, especially when masks are worn for too long, not properly stored, or re-used without proper disinfection. In fact, the human saliva contains 100 million bacterial cells per milliliter and harbors a range of pathobionts, including *Staphylococcus aureus, Pseudomonas aeruginosa, Candida albicans, Klebsiella pneumoniae, Neisseria, Prevotella*, and *Veillonella spp.* (28–31). Furthermore, cotton serves as substrate for microbial growth (32) and is able to retain moisture, making cotton masks more favorable for high microbial contamination than surgical masks. In addition, the reuse of cotton masks, moisture retention and poor filtration may result in increased risks of transmission of respiratory viruses compared to surgical masks (9).

Policy makers are beginning to recognize the biosafety hazards of wearing non-professional face masks. The Belgian government recommends that after 8 h of regular use or 4 h of intensive use (e.g., intensive speaking during teaching), the face mask should be replaced or cleaned (33). Used fabric face masks should be kept in a closed cloth bag and washed together. It is recommended to wash (60°C with detergent), boil (100°C), or iron the masks to disinfect them after use. After disinfection, the mask should be completely dried before wearing it again (33). Nevertheless, the general population is not yet properly educated to handle face masks. An observational checklist with 1,500 participants recruited in Hong Kong showed that almost none of them were able to perform all the required steps in using a face mask correctly, as 91.5% did not perform hand hygiene before putting the mask on and 97.3% when taking it off (34). Improper use of face masks can lead to a higher risk of infection with and spreading of viral and bacterial pathogens. Self-inoculation of mucous membranes of nose, eyes, and mouth is an important transmission route of viruses (35), as people touch their face ~23 times per hour of which 44% involves contact with a mucous membrane (36). Moreover, people may pay less attention to other important measures such as social distancing and hand hygiene (24, 37). Lastly, face mask use can be associated with discomfort, skin acne, headaches, respiratory distress, difficulties in communication (especially for deaf or hard of hearing persons), as well as less non-verbal communication (24, 38, 39).

In this study we compared the bacterial load and microbiome composition on certified disposable surgical masks and self-made cotton masks, to evaluate some risks for bacterial cross-contamination. We also performed microbiome profiling of the cheek and anterior nares before and after wearing the face mask in order to detect shifts in the microbiome caused by face mask wearing. Particular attention was given to antibiotic-resistant bacteria, putative food-related pathogens, and skin and respiratory pathobionts. In parallel, as part of a large-scale survey conducted by the University of Antwerp, we assessed the hygiene habits, preferences, opinions, and influences on social behavior related to face masks in the Belgian population.

MATERIALS AND METHODS

Microbiological Mask Study Design

The protocol of this study was in accordance with the Declaration of Helsinki. The study was approved by the ethical committee of the University Hospital of Antwerp (Belgium). The study was given the approval number B3002021000072 (Belgian registration) and was registered online at clinicaltrials.gov with unique identifier NCT04894422.

Healthy volunteers (four males and nine females) aged 24-33 who wore surgical (certified as medical device) and/or a self-made cotton masks (stitching pattern used is presented in Supplementary Figure 1) in an indoor setting were asked to return their mask after 4 h wearing. All healthy volunteers were non-smokers, non-healthcare workers and did not take any antibiotics, nor had a hospital stay in the previous month before the start of the study. All cotton masks were made according to the instructions recommended by the Belgian government (pattern with specific measurements can be found in Supplementary Figure 1), initially cleaned by washing at 60°C with detergent and stored in a closed ziplock bag until use. In total, 21 masks, worn for 4 h, were collected. The face masks were then cut in half using sterile scissors under sterile conditions. One half of the mask was cut in smaller pieces and put in a 50 ml conical tube. Fifteen ml of sterile phosphate-buffered saline (PBS) was added and the tube was vortexed for 30 s. The suspension was plated out in serial dilutions in PBS for bacterial colony forming unit (CFU) counts and used for DNA extraction (more details under "Microbiology methods"). The other half of the mask was cleaned in a home setting by soaking in boiling water for a few minutes (100°C), washing in a washing machine at 60°C with detergent, ironing with a steam iron for ~2 min, leaving overnight in the freezer at (avg. −18°C), or leaving at room temperature for 72 h. After treatment, the cleaned

half of the mask was processed and plated out as described for the first half. To check initial bacterial load on the mask, clean and never-used cotton (5) and surgical masks (7) were plated out for bacterial loads as described previously.

Additionally, we collected a non-invasive nasal swab (anterior nares) [Nasal swab Copan (catalog number 503CS01)] and a non-invasive skin swab (cheek skin) (eNAT swab) of 10 participants before and after wearing the face mask after approval of the ethical committee (B3002021000072). All participants gave their consent before swabs were collected. Skin swabs were stored at 4°C (max 24 h) prior to DNA extraction and 500 µl of the eNAT buffer was used for the DNA extraction. Nasal swabs were immediately suspended in 750 µl MoBio bead solution (PowerFecal DNA Isolation Kit; MO BIO Laboratories Inc., Carlsbad, CA, United States) and kept at 4°C (max 24 h) until further processing.

Bacterial Isolation and Culturing

Brain Heart Infusion (BHI) agar (LAB M, Lancashire, UK) and Lysogeny Broth (LB) agar (Carlroth, Karlsruhe, Germany) plates (composition given in Supplementary Table 2), containing 1.5% (v/w) agar, were used to determine the bacterial load on the face masks before and after wearing and cleaning. The bacterial load was determined in colony forming units per ml (CFU/ml) of resuspension medium and recalculated to CFU/mask. The face mask suspension was diluted 10 times and 100 µl of undiluted and diluted suspensions were plated out on both growth media. Plates were incubated overnight at 37°C in aerobic conditions. CFUs were counted and a total of 47 colonies were isolated, subjected to colony PCR and identified using Sanger sequencing as described below. For isolation, colonies were transferred to BHI or LB liquid medium, grown statically at 37°C overnight and used for making glycerol stocks in 25% v/v glycerol stored at −80°C. To determine antibiotic resistance, the isolates were plated out on LB or BHI agar containing ampicillin and erythromycin, each at 100 µg/mL; final concentration.

Taxonomic Identification of Isolates by Sanger Sequencing of the 16S rRNA Gene

Grown isolates were further identified with PCR and Sanger sequencing of the 16S rRNA gene. The target region was amplified by using 27 forward primer (27f 5′-AGAGTTTGATCCTGGCTCAG-3′) and 1492 reverse primer (1492r 5′-CTACGGCTACCTTGTTACGA-3′) (40, 41). Sanger sequencing was performed at the "VIB genetic service facility" (University of Antwerp) on a capillary sequencer (Applied Biosystems 3730XL DNA Analyzer) and ABI PRISM® BigDye™ Terminator cycle sequencing kit. The Sanger sequencing data was analyzed with Geneious prime (version 2020.0.5), ends of sequenced reads were trimmed with an error probability limit of 0.05, the sequences were assembled and the quality of the assemblies was assessed. Finally, all the assemblies were blasted in the NCBI database.

Bacterial DNA Extraction From Swabs

The PowerFecal DNA Isolation Kit was used to extract microbial DNA from anterior nares and cheek swabs. DNA extraction was performed according to the instructions of the manufacturer. Negative extraction controls were extracted at regular time points throughout the study. DNA concentrations were measured using the Qubit 3.0 Fluorometer (Life Technologies, Ledeberg, Belgium).

Illumina MiSeq 16S rRNA Gene Amplicon Sequencing

Illumina MiSeq 16S rRNA gene amplicon sequencing was performed on the extracted DNA from the nasal and skin swabs as well as on the PBS suspension of the face masks to determine the taxonomic composition of the bacterial communities. An in-house optimized protocol for low-biomass samples was followed, as described (42). Briefly, 5 µl of bacterial DNA sample was used to amplify the V4 region of the 16S rRNA gene. All DNA samples and negative controls of both PCR (PCR grade water) and the DNA extraction kit were included. Standard barcoded forward (515F)

and reverse primer (806R) were used. These primers were altered for dual index paired-end sequencing, as described in (43). The resulting PCR products were checked on a 1.2% agarose gel. The PCR products were purified using the Agencourt AMPure XP Magnetic BeadCapture Kit (Beckman Coulter, Suarlee, Belgium) and the DNA concentration of all samples was measured using the Qubit 3.0 Fluorometer. Next, a library was prepared by pooling all PCR samples in equimolar concentrations, loaded onto a 0.8% agarose gel and purified using the NucleoSpin Gel and PCR clean-up (Macherey-Nagel). The final DNA concentration of the library was measured with the Qubit 3.0 Fluorometer. Afterwards the library was denatured with 0.2N NaOH (Illumina), diluted to 7 pM and spiked with 10% PhiX control DNA (Illumina). MiSeq Desktop sequencer (M00984, Illumina) was used for sequencing.

Processing and quality control of the reads were performed using the R package DADA2, version 1.6.0. Further processing of the ASV table, AVS annotation (e.g., classification), sample annotation (metadata) and data visualization and statistical analysis was performed in R version 4.0.3 (44), using the in-house package tidyamplicons, version 0.2.1 [publicly available at github.com/SWittouck/tidyamplicons), as described in (42)]. Alpha- and beta-diversity analysis were also performed as described before in (42).

Large-Scale Survey on Face Mask Use and Attitudes

On August 19th, 2020, 24.948 people filled in the University of Antwerp Great Corona survey through the online survey system Qualtrics. Questions regarding the hygiene habits, preferences, opinions, and influences on social behavior related to face masks in the Belgian population were included. This citizen science project was organized by the Centre for Health Economics Research and Modelling Infectious Diseases (University of Antwerp), Data Science Institute (University of Hasselt), the SIMID collaboration, the Centre for the Evaluation of Vaccination (University of Antwerp) and Koen Pepermans (Faculty of Social Sciences, University of Antwerp). The Great Corona survey is supported by the Research Foundation Flanders (Grant G0G1920N, 2020).

Statistical Analysis

Statistical analysis was performed in R for 16S amplicon sequencing data and GraphPad Prism version 8.4.3 for other data. The following statistical tests were used: Wilcoxon test and multiple *t*-tests, Kruskal-Wallis test with multiple comparisons, two-way ANOVA with Sidak's multiple comparisons test.

Data Availability

Sequencing data are available at the European Nucleotide Archive with the accession number PRJEB45406.

RESULTS

Bacterial Composition of Surgical and Cotton Face Masks After Use

An overview of the study design can be found in the graphical abstract in Figure 1. In total, the bacterial load and composition of 23 cotton and 9 surgical masks, worn for 4 h by the participants, was determined. The initial bacterial load of clean and never used cotton face masks was 1.44×10^1 CFU/mask (mean, SD = 1.09×10^3) on Lysogeny Broth (LB) agar and 1.50×10^1 CFU/mask (mean, SD = 1.51×10^3) on Brain Heart Infusion (BHI) agar (average of 1.47×10^1 CFU/mask). For the surgical masks, the initial load was 1.29×10^2 CFU/mask (mean, SD = 1.60×10^2) on LB and 4.29×10^1 CFU/mask (mean, SD = 1.31×10^3) on BHI (average of 8.60×10^1 CFU/mask). After 4 h of wearing, the cotton masks contained a mean of 1.38×10^5 CFU/mask (SD = 1.95×10^5) counted on LB and 1.53×10^5 CFU/mask (SD = 1.96×10^5) on BHI growth medium (average of 1.46×10^5 CFU/mask). The surgical masks contained a mean of 1.79×10^4 CFU/mask (SD = 1.63×10^4) on LB and 2.18×10^4 CFU/mask (SD = 2.76×10^4) on BHI (average of 1.32×10^4 CFU/mask). So after

wearing, the cotton masks contained significantly more CFU/mask for both growth media (p = 0.021, LB; p = 0.014, BHI) (Figure 2A). However, a higher increase in bacterial load compared to the initial bacterial load was seen for surgical masks. Overall, high interindividual variation in the bacterial load on the face masks after wearing was seen, represented in the high standard deviations.

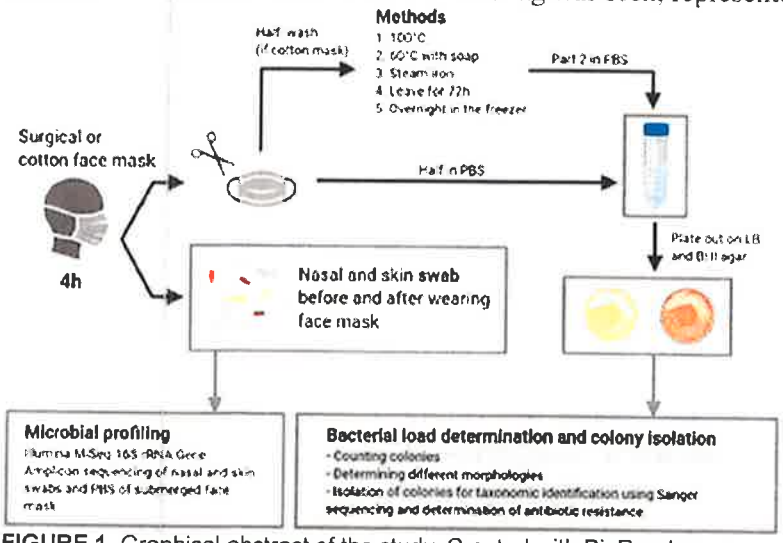

FIGURE 1. Graphical abstract of the study. Created with BioRender.com.

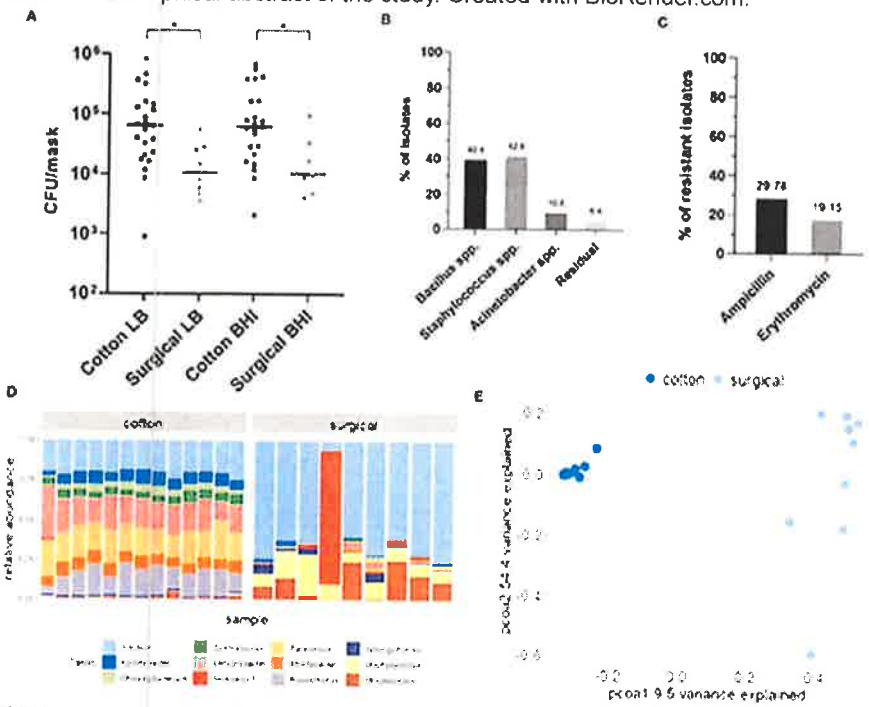

FIGURE 2. Analysis of the bacterial composition of cotton and surgical face masks after 4 h of wearing. **(A)** Mask bacterial load quantified *via* culturing on LB and BHI agar plates after 4 h of wearing. Data shown the mean CFU/mask (calculated to represent the whole face mask) for both growth media and mask types. Statistics were performed using ANOVA with Kruskal-Wallis multiple comparisons test $^*p < 0.05$. **(B)** Identification of selected bacterial isolates cultured from both types of face masks through Sanger sequencing of the V4 region of the 16S rRNA gene. **(C)** Percentages of isolates cultured from both types of face masks that showed resistance to the antibiotics ampicillin and erythromycin. **(D)** Taxonomic bacterial community composition on the face masks at genus-level where each bar represents a participant, analyzed *via* 16S rRNA amplicon sequencing. **(E)** Principal Coordinates Analysis (PCoA) plot distributing the samples according to beta-diversity (Bray-Curtis distance).

Samples are colored by type of mask. LB, Luria-Bertani broth; BHI, Brain Heart Infusion; AB, antibiotic; C, cotton face mask; S, surgical face mask.

Based on colony morphology, we selected 47 individual colonies from across all mask types for identification using 16S rRNA gene-based Sanger sequencing. Most colonies were identified as *Bacillus* or *Staphylococcus* species, comprising, respectively, 40.4 and 42.6% of all selected colonies (Figure 2B). Among the *Bacillus* species, *Bacillus thuringiensis* and *Bacillus cereus* were most represented (Supplementary Table 1). Among the *Staphylococcus* species, we found mostly *Staphylococcus epidermidis*, as well as *Staphylococcus aureus, Staphylococcus warneri*, and *Staphylococcus caprae*, which are known species of a healthy human skin and nasal microbiome (42, 45–47). Furthermore, 10.6% of all colonies was identified as *Acinetobacter* spp., which are also considered a part of the normal human skin and respiratory microbiome (48, 49). Along with the three most abundant isolated species, residual isolates included *Pantoea, Lysinibacillus*, and *Solibacillus* species.

Antibiotic-resistant bacteria are a worldwide problem as infections caused by these micro-organisms are more difficult to treat and can lead to higher medical costs, prolonged hospital stays and increased mortality. Therefore, we tested the resistance of all bacterial isolates to two commonly used antibiotics for respiratory infections: erythromycin and ampicillin, a macrolide and beta-lactam antibiotic, respectively. Both antibiotics are active against important respiratory pathogens and resistance to both is increasing (50–55). Of the 47 isolated colonies, 43% showed full antimicrobial resistance to at least one of the tested antibiotics: 30% of the isolates were resistant against ampicillin and 19% against erythromycin (Figure 2C). Six percent of all colonies showed resistance against both antibiotics.

In addition to cultivation-based methods, we analyzed the microbiome composition of masks using 16S rRNA gene amplicon sequencing (Figure 2D). Not-worn face masks were not used in this step as the amount of bacterial cells was too low to be detected using this method. The bacterial community residing in the cotton face masks after 4 h of wearing were mainly represented by *Roseomonas, Paracoccus*, and *Enhydrobacter*, with mean relative abundances of 15.23, 19.00, and 19.28%, respectively. In contrast, the microbial communities found on the surgical masks consisted mostly of *Streptococcus* (mean relative abundance 11.31%) and *Staphylococcus* (mean relative abundance 11.03%). These genera are also present on the cotton masks, but in lower relative abundances, 4% for *Staphylococcus* and 3% for *Streptococcus*.

In order to explore the differences in beta-diversity (measured in terms of Bray-Curtis distance) between the cotton and surgical face masks, Principal Coordinates Analysis (PCoA) was used. Based on the type of mask, two clear clusters could be observed presenting either the cotton or surgical masks (Figure 2E). A significant impact of the type of face mask on the alpha diversity was observed, measured with inverse Simpson index ($p = 0.0033$, Supplementary Figure 3).

Cleaning Methods for Cotton Face Masks

In order to select the most effective method to reduce bacterial loads after wearing cotton masks, different cleaning methods were evaluated. Cleaning methods were determined as effective when a reduction in microbial biomass of 90% was established. A reduction in CFU/mask of 95.8%, 63.6% and 99.8% on both LB and BHI growth media was detected after boiling the mask at 100°C, washing at 60°C with detergent, and ironing with a steam iron, respectively. Keeping the mask overnight at −18°C and leaving the mask at room temperature for 72 h did not reduce the detected CFU counts observed after 4 h of wearing. Even more, a trend toward an increase in CFU/mask was observed by 34.1 and 183.3%, respectively, when using the latter cleaning methods (Figure 3A). The relative taxonomic abundances within the cotton face mask microbiome stayed stable after cleaning, except for washing at 60°C with detergent (Figure 3B), suggesting that this method also effectively removes the inactivated bacterial cells from the masks. *Roseomonas, Paracoccus*, and

Enhydrobacter still dominated the face masks for more than 40% after boiling, ironing, leaving it at RT or at −18°C (Figure 3B). However, the total microbial load decreased up to over 90% for the effective cleaning methods, i.e., boiling at 100°C, washing at 60°C with detergent and ironing with a steam iron. This was expected since bacterial cells remained on the face masks after ironing and boiling as these methods kill bacterial cells, but don't remove them from the mask. Thus, DNA could still be extracted and sequenced. Washing at 60°C with detergent in a washing machine seems to be the only method that removed bacterial cells which is supported by the sequencing data (Figure 3B), where a change in relative abundances can be seen after cleaning.

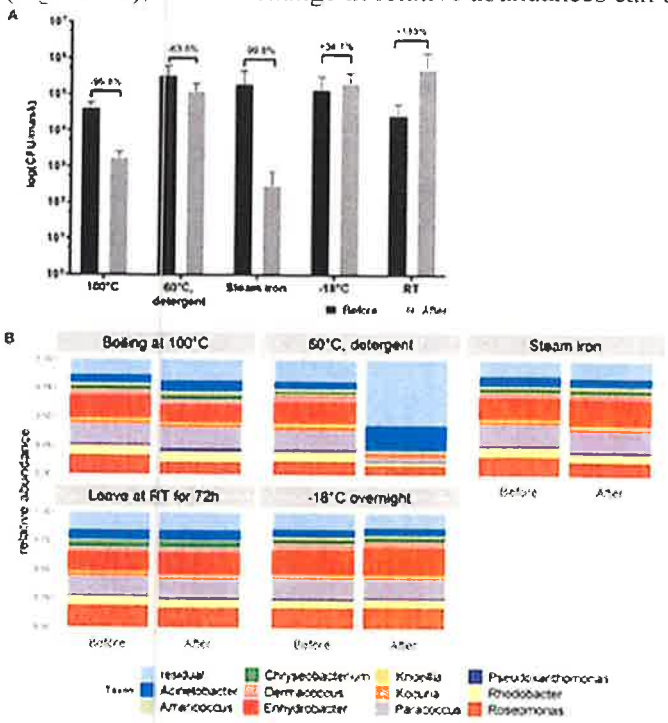

FIGURE 3. Evaluation of different cleaning methods to reduce bacterial load on cotton face masks. **(A)** Cotton mask bacterial load before and after mask cleaning. Data shown as the average CFU/mask (calculated to represent the whole face mask) after cultivation on BHI agar (cultivation on LB agar in Supplementary Figure 2). Statistics were performed using two-way ANOVA with Sidak's multiple comparisons test. No significant differences were detected. **(B)** Taxonomic bacterial community composition on the face masks at genus level for the different cleaning methods, before and after cleaning, analyzed *via* 16S rRNA gene amplicon sequencing.

Effect of Wearing a Face Mask on the Nasal and Skin Microbiome

In addition to studying the microbial communities of the face masks themselves, we also studied the effect of wearing the face mask for 4 h on the nasal (anterior nares) and skin (cheek) microbiome. Taxonomic microbiome profiles at ASV-level of the skin and nasal swabs are depicted in Supplementary Figure 4. Community structures for skin and nasal swabs were assessed using Bray-Curtis beta-diversity measures grouped by type of face mask (Figure 4A). The summed differences in read counts for all taxa across the different participants were analyzed with pairwise Bray-Curtis dissimilarities, comparing the beta-diversity before and after wearing the face mask. A beta-diversity of 0 indicates that the bacterial content before and after is the same, whereas a beta-diversity of 1 means that the bacterial profiles differ completely. For the skin microbial composition, a Bray-Curtis dissimilarity of 42% was observed, while this was 27% for the anterior nares, indicating that the skin microbiome profiles are somewhat more influenced by mask wearing than the nasal microbiome profiles. Additionally, alpha diversity measured by inverse Simpson is depicted in Figure 4B. No effect of wearing the face mask for 4 h on alpha-diversity in skin or nasal

microbiome was observed by inverse Simpson index (p = 0.97 for anterior nares and p = 0.75 for skin).

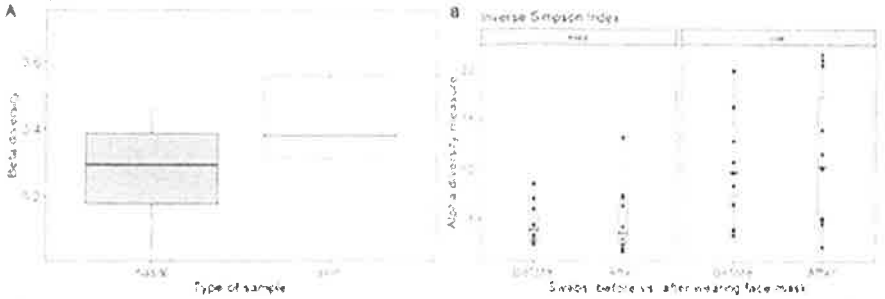

FIGURE 4. Analysis of the bacterial composition of the nasal and skin microbiome before and after wearing a face mask for 4 h. **(A)** Beta-diversity by Bray-Curtis dissimilarities, comparing the beta-diversity of the skin and nasal microbiome before and after wearing a face mask for 4 h. **(B)** Alpha-diversity by Inverse Simpson Index, grouped by time point (before and after wearing a face mask) and plots split for nasal and skin microbial samples.

Survey on Mask Use and Attitudes

To investigate whether some concerns could be raised about the mask use and hygiene in the general population, some questions were included in the 2-weekly Corona survey of the University of Antwerp on August 19, 2020. Relevant questions for this paper are listed in Supplementary Table 3. Approximately 25,000 people had filled in the questionnaire. At that moment, face masks were obligatory in public settings where a distance of 1.5 m could not be maintained, and only 21% of the responders claimed not to use a face mask daily. Regarding duration of use, 48% indicated that they did wear one for <1 h, 28% for 1-2 h, 12% for 2-4 h, 9% for 4-8 h, and 2% for more than 8 h each day. Based on the survey, no clear preference for a type of mask was observed, as 44 and 43% of the people choose to wear a surgical or cotton face masks, respectively (Figure 5A). Related to hygiene, only 8% of surgical mask users reported that they did throw it away after each use and 15% indicated that they only throw it away when it was visibly dirty or damaged (Figure 5D). Of the cotton-mask wearers, 18% indicated to wash the masks after every use independent of time, 21% performed a daily cleansing, 27% reported to only wash it once a week, and 6% indicated to never have washed their reusable face mask (Figure 5C). From all participants, also 36% claimed to have some health complaints when wearing a face mask, of which 7% reported sinusitis, 16% acne, and 77% other complaints (amongst others headache, skin irritation, and breathing difficulties).

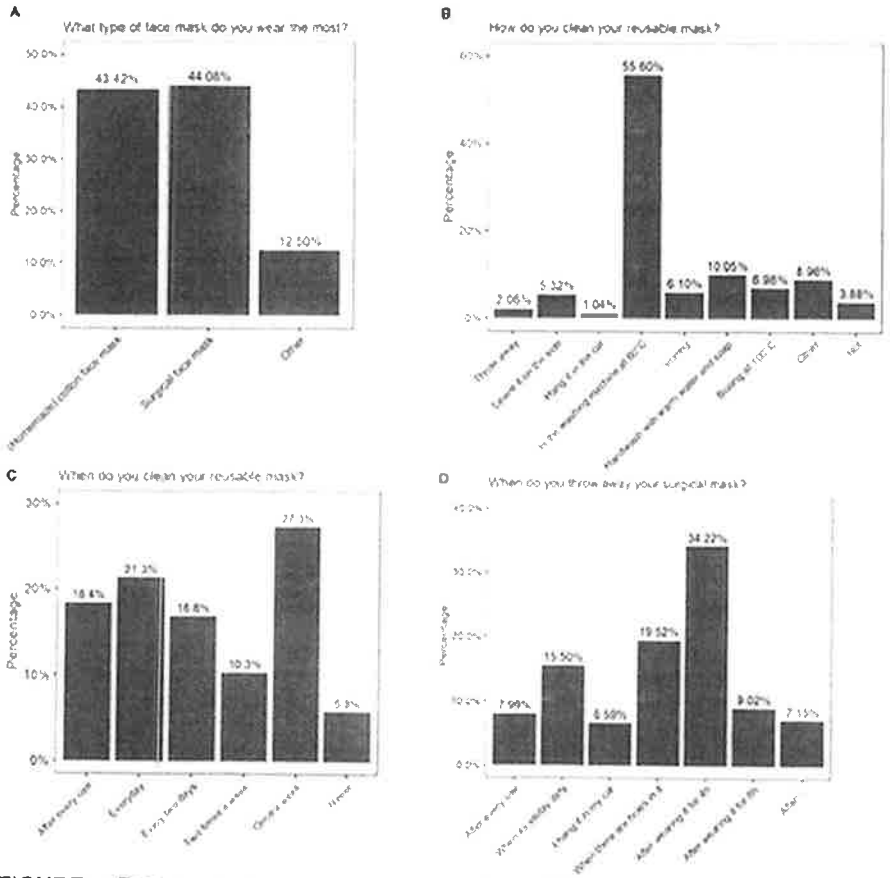

FIGURE 5. Results of a large-scale survey conducted by the University of Antwerp, filled in by over 25,000 people. Answers to the questions **(A)** "What type of face mask do you wear the most?" **(B)** "How do you clean your reusable mask?" **(C)** "When do you clean your reusable mask?" and **(D)** "When do you throw away your surgical mask?" are depicted as percentages.

DISCUSSION

While a number of studies have focused on the importance of face masks in the transmissions of respiratory viruses (2, 17, 26), accumulation of pathobionts on the masks due to human saliva and exhaled breath represents a possible underestimated biosafety concern. Microorganisms present on the skin and in the upper respiratory tract could be transferred to the face mask while wearing it. For optimal growth, bacterial cells need a surface to grow on, warmth, moisture, and nutrients, which is the environment created on the face mask due to exhaled air and water vapor (56). Growth of these microorganisms will also increase the amount of bacteria that are inhaled or could be transferred to the skin. This could theoretically cause some disturbance in the skin and nasal microbiome due to for instance the overgrowth of certain pathobionts, which are associated with an increased risk of inflammation and infections (57). For example, research has found that *S. aureus* is part of a healthy skin microbiome, but can cause skin infections when the abundance of this species increases (58). In several studies, the use of face masks has been associated with acne linked to an accumulation of *S. aureus* (59–61).

Here, we evaluated the bacterial load on cotton and surgical face masks after wearing them for 4 h, and the effects of different cleaning methods on this bacterial load and community composition. Furthermore, changes in nasal and cheek skin microbiome due to mask usage were analyzed. We detected a significant accumulation of bacteria on the cotton mask (mean of 1.48×10^8 CFU/mask)

as well as the surgical masks (mean of 1.98×10^4 CFU/mask) after 4 h of wearing. However, these surgical masks were more sterile at the start so a larger difference in bacterial load was to be expected. Although all self-made cotton masks were cleaned beforehand, a considerable amount of bacteria was still detected (1.44×10^7 CFU/mask on LB and 1.50×10^7 CFU/mask on BHI). Based on our results and previous research, surgical masks appear to be the better option regarding bacterial load accumulation when masks need to be worn for at least 4 h (62). This could be due to the lower water retention of surgical masks compared to cotton masks, as well as their better ventilation properties (56). The latter results in a lower temperature inside the mask, which, together with lower humidity levels, is a less ideal environment for bacterial growth and so a lower bacterial growth compared to cotton masks (56).

Cotton or cloth masks are known to be a good substrate for microbial growth and to hold moisture very well, which is in line with the results obtained in this study and is also observed by others (32). Zhiqing et al. have shown that the bacterial count on face masks of surgeons was directly proportional with the operating time (62). Therefore, we hypothesize that this bacterial load will be even greater after 8 h, which is the maximal wearing time recommended by the government. However, people indicated to wear it even more than the recommended 8 h.

In addition to the bacterial load, also the bacterial composition is an important factor to consider. Here, we evaluated both the microbiome on the mask, as well as changes on the nasal and cheek microbiome before and after wearing a cotton mask. The latter has—to the best of our knowledge—never been examined before. In this study, the microbiome on cotton face masks after 4 h of wearing was mainly represented by *Roseomonas, Paracoccus*, and *Enhydrobacter* taxa, whereas the surgical face mask microbiome consisted mostly of *Streptococcus* and *Staphylococcus* taxa, which were also found on the cotton masks, albeit in much lower abundances. Our cultivation results detected specific strains belonging to genera such as *Staphylococcus* spp., *Bacillus* spp., *Acinetobacter* spp. that are known to be associated with the skin and respiratory tract (49, 63). For example for *Staphylococcus* spp., *S. epidermidis, S. warneri*, and *S. caprae* are known as commensals on the human skin, maintaining the healthy skin (46). However, *S. epidermidis* and *S. aureus* are also known as pathobionts causing inflammatory skin conditions such as atopic dermatitis and acne vulgaris (64–68). *S. aureus* is also a colonizer of the airways due to the expression of surface adhesins and is known as a commensal bacterium as well as an important pathogen, causing respiratory tract infections (69, 70). Additionally, *Acinetobacter* spp. is also considered a part of the healthy human skin and respiratory microbiome (48, 49). However, other members of this genus, such as *Acinetobacter baumanni*, can cause wound infections and pneumonia (49).

We also tested the accumulation of antibiotic-resistant strains on the face masks, as antibiotic-resistant strains are a worldwide problem and it is believed that by 2050 more people will die from an antibiotic-resistant bacterial infection than from cancer (52). Especially *S. aureus* and *A. baumanni* are part of the *Enterococcus faecium, Staphylococcus aureus, Klebsiella pneumoniae, Acinetobacter baumannii, Pseudomonas aeruginosa*, and *Enterobacter* species (ESKAPE) pathogens, which is a group of bacteria that causes life-threatening nosocomial infections and are characterized by potential drug resistance mechanisms (55). Approximately 43% of selected colonies were resistant to at least one of the two tested antibiotics (ampicillin and erythromycin) and 6% was even resistant to both. Erythromycin is a macrolide antibiotic active against many respiratory pathogens (50). However, due to the extensive use of macrolide antibiotics, respiratory pathogens show increasing resistance to macrolides (51, 54). The same is true for ampicillin, a beta-lactam antibiotic equivalent to amoxicillin in terms of activity (71, 72). In our study, 21.3 and 38.5% of the isolates was resistant to ampicillin and erythromycin, respectively. In the future, larger microbiological studies including different age and socioeconomic groups are warranted to extrapolate our findings to a larger population.

Considering the high detected bacterial load, it is important that surgical masks are disposed and that cotton masks are disinfected properly after each use. Our analysis indicated that boiling at 100°C, washing at 60°C with detergent, or ironing with a steam iron are most effective in reducing microbial load on cotton face masks. In general, we observed a considerable survival of *Bacillus spp.* after cleaning the cotton face masks. *Bacillus spp.* are spore-forming bacteria and are therefore more resistant to environmental stress factors such as heat (73). In addition, washing at 60°C with detergent was the only method that removed bacterial DNA on the face masks, which was reflected in our sequencing data since the microbial profile changed (Figure 2B). Boiling at 100°C and ironing did significantly inactivate the present bacteria (Figure 3A), but amplicon sequencing showed that the bacterial DNA remained on the face masks after cleaning (Figure 2B). These methods are in line with the Belgian government regulations to wash a cotton face mask every 8 h or after 4 h of intensive use. However, in the survey done by the University of Antwerp, Belgium, it was clear that not everyone followed these recommendations. Only the minority of survey participants (39%) claimed to wash their cotton face mask after every use or every day (Figure 5B).

In addition to culture-based approaches, we also analyzed the impact of wearing a face mask (cotton and surgical) on the nasal and skin microbiome by DNA-based analysis of swabs. Since there was only 4 h in between the sampling points (before and after wearing the face mask), we hypothesized no significant effect on the microbiome would be observed. Indeed, wearing a cotton or surgical mask for 4 h did not significantly influence specific taxa of the nasal or skin microbiome. Also for the Bray-Curtis beta diversity analysis, no difference was observed, although a trend toward a change in community structures of the skin microbiome could be observed. In theory, this change could imply a negative or beneficial effect on the microbiome. However, based on other clinical research regarding the effect of face masks on the skin, we expect that the change in microbiome composition would rather be unfavorable (59–61, 74). More large-scale longitudinal microbiome analyses are thus needed to investigate whether there might be an association of a wearing a mask and changes in the skin and/or nasal microbiome when worn for longer time periods.

CONCLUSIONS

Bacteria, and specifically pathobionts, accumulate on both surgical and more so on cotton face masks after 4 h of wearing. When the same face masks are worn for longer periods of time, surgical masks might be a better option due to a lower bacterial load. In addition, surgical face masks should probably best be disposed of after every use and cotton face masks should be properly sterilized. The latter can be efficiently done by boiling at 100°C, washing at 60°C with detergent, and ironing using a steam iron. More research is required to investigate whether mask use beyond 4 h could lead to a dysbiosis in the skin and nasal microbiome and be associated to conditions such as acne. This research emphasizes that face masks should be better evaluated to weigh the risks of disease transmission rate against other biosafety risks such as bacterial overgrowth, especially in vulnerable populations and in situations where physical distancing and proper ventilation are available.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: https://www.ebi.ac.uk/ena/browser/view/PRJEB45406?show=reads.

ETHICS STATEMENT

The studies involving human participants were reviewed and approved by Ethical committee University Hospital Antwerp (UZA). The patients/participants provided their written informed consent to participate in this study.

AUTHOR CONTRIBUTIONS

Data-analyses and visualization was performed by EC, LD, and WV. Data interpretation was done by EC, LD, IS, ID, DV, IC, and SL. Ethical committee submission was done by EC, LD, ID, VV, and SL. Special thanks to the Research Foundation Flanders and KP for making it possible to include questions relevant for this research in the Great Corona survey. The original draft was written by EC, LD, and SL. All authors worked on the conceptualization of the research projects, contributed to reviewing and editing of the paper, and proofread and approved the manuscript.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmed.2021.732047/full#supplementary-material

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Review

Is a Mask That Covers the Mouth and Nose Free from Undesirable Side Effects in Everyday Use and Free of Potential Hazards?

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Abstract: Many countries introduced the requirement to wear masks in public spaces for containing SARS-CoV-2 making it commonplace in 2020. Up until now, there has been no comprehensive investigation as to the adverse health effects masks can cause. The aim was to find, test, evaluate and compile scientifically proven related side effects of wearing masks. For a quantitative evaluation, 44 mostly experimental studies were referenced, and for a substantive evaluation, 65 publications were found. The literature revealed relevant adverse effects of masks in numerous disciplines. In this paper, we refer to the psychological and physical deterioration as well as multiple symptoms described because of their consistent, recurrent and uniform presentation from different disciplines as a Mask-Induced Exhaustion Syndrome (MIES). We objectified evaluation evidenced changes in respiratory physiology of mask wearers with significant correlation of O_2 drop and fatigue ($p < 0.05$), a clustered co-occurrence of respiratory impairment and O_2 drop (67%), N95 mask and CO_2 rise (82%), N95 mask and O_2 drop (72%), N95 mask and headache (60%), respiratory impairment and temperature rise (88%), but also temperature rise and moisture (100%) under the masks. Extended mask-wearing by the general population could lead to relevant effects and consequences in many medical fields.

Keywords: personal protective equipment; masks; N95 face mask; surgical mask; risk; adverse effects; long-term adverse effects; contraindications; health risk assessment; hypercapnia; hypoxia; headache; dyspnea; physical exertion; MIES syndrome

1. Introduction

At the beginning of the spread of the novel pathogen SARS-CoV-2, it was necessary to make far-reaching decisions even without available explicit scientific data. The initial assumption was that the pandemic emergency measures were set in place to reduce the acute threat of the public health system effectively and swiftly.

In April 2020, the World Health Organization (WHO) recommended the use of masks only for symptomatic, ill individuals and health care workers and did not recommend its widespread use.

In June 2020, they changed this recommendation to endorse the general use of masks in, e.g., crowded places [1,2]. In a meta-analysis study commissioned by the WHO (evidence level Ia), no clear, scientifically graspable benefit of moderate or strong evidence was derived from wearing masks [3].

While maintaining a distance of at least one meter showed moderate evidence with regard to the spreading of SARS-CoV-2, only weak evidence at best could be found for masks alone in everyday use (non-medical setting) [3]. Another meta-analysis conducted in the same year confirmed the weak scientific evidence for masks [4].

Accordingly, the WHO did not recommend general or uncritical use of masks for the general population and expanded its risk and hazard list within just two months. While the April 2020 guideline highlighted the dangers of self-contamination, possible breathing difficulties and false sense of security, the June 2020 guideline found additional potential adverse effects such as headache, development of facial skin lesions, irritant dermatitis, acne or increased risk of contamination in public spaces due to improper mask disposal [1,2].

However, under pressure from increasing absolute numbers of positive SARS-CoV-2 tests, many prescribers further extended mask-wearing according to certain times and situations, always justified by the desire to limit the spread of the virus [5]. The media, numerous institutions and most of the population supported this approach.

Among the medical profession and scientists, the users and observers of medical devices, there have been simultaneous calls for a more nuanced approach [6–8]. While there has been a controversial scientific discussion worldwide about the benefits and risks of masks in public spaces, they became the new social appearance in everyday life in many countries at the same time.

Although there seems to be a consensus among the decision makers who have introduced mandatory masks that medical exemptions are warranted, it is ultimately the responsibility of individual clinicians to weigh up when to recommend exemption from mandatory masks. Physicians are in a conflict of interest concerning this matter. On the one hand, doctors have a leading role in supporting the authorities in the fight against a pandemic. On the other hand, doctors must, in accordance with the medical ethos, protect the interests, welfare and rights of their patient's third parties with the necessary care and in accordance with the recognized state of medical knowledge [9–11].

A careful risk–benefit analysis is becoming increasingly relevant for patients and their practitioners regarding the potential long-term effects of masks. The lack of knowledge of legal legitimacy on the one hand and of the medical scientific facts on the other is a reason for uncertainty among clinically active colleagues.

The aim of this paper is to provide a first, rapid, scientific presentation of the risks of general mandatory mask use by focusing on the possible adverse medical effects of masks, especially in certain diagnostic, patient and user groups.

2. Materials and Methods

The objective was to search for documented adverse effects and risks of different types of mouth–nose-covering masks. Of interest here were, on the one hand, readymade and self-manufactured fabric masks, including so-called community masks and, on the other hand medical, surgical and N95 masks (FFP2 masks).

Our approach of limiting the focus to negative effects seems surprising at first glance. However, such an approach helps toprovide us with more information. This methodology is in line with the strategy of Villalonga-Olives and Kawachi, who also conducted a review exclusively on the negative effects [12].

For an analysis of the literature, we defined the risk of mouth–nose protection as the description of symptoms or the negative effects of masks. Reviews and expert presentations from which no measurable values could be extracted, but which clearly present the research situation and describe negative effects, also fulfill this criterion.

Additionally, we defined the quantifiable, negative effect of masks as the presentation of a measured, statistically significant change in a physiological parameter in a pathological direction ($p < 0.05$), a statistically significant detection of symptoms ($p < 0.05$) or the occurrence of symptoms in at least 50% of those examined in a sample ($n \geq 50\%$).

Up to and including 31 October 2020, we conducted a database search in PubMed/MEDLINE on scientific studies and publications on adverse effects and risks of different types of mouth–nose-covering masks according to the criteria mentioned above (see Figure 1: Review flowchart). Terms searched were "face masks", "surgical mask" and "N95" in combination with the terms "risk" and "adverse effects" as well as "side effects". The selection criteria of the papers were based on our above definition of risk and adverse effect of masks. Mainly English- and German-language publications of evidence levels I to III according to the recommendations of the Agency for Healthcare Research and Quality (AHQR) that were not older than 20 years at the time of the review were considered. The evaluation also excluded level IV evidence, such as case reports and irrelevant letters to the editor that exclusively reflect opinions without scientific evidence.

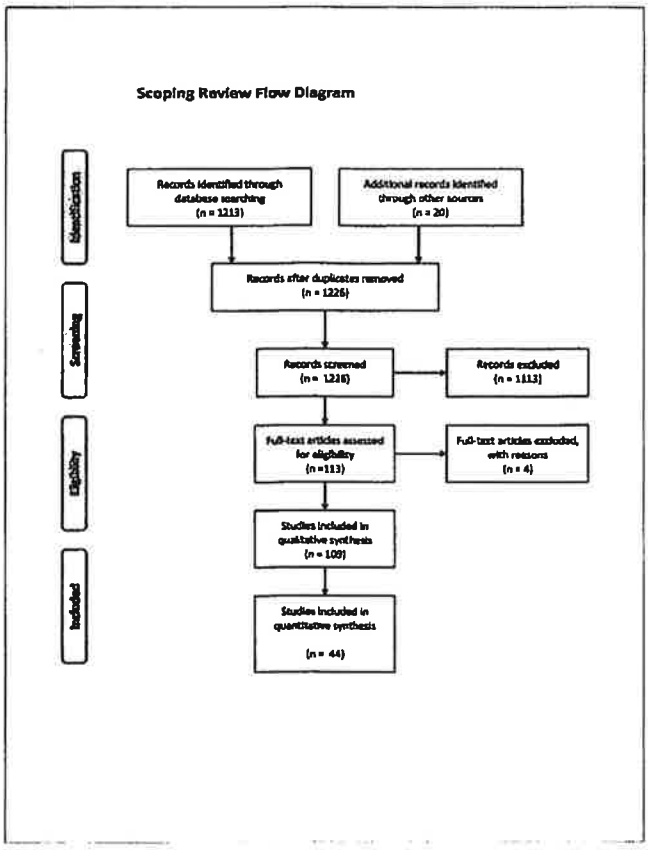

Figure 1. Scoping review flow diagram according to the PRISMA scheme.

After excluding 1113 papers that were irrelevant to the research question and did not meet the criteria mentioned (quantifiable, negative effects of masks, description of symptoms or the negative effects of masks), a total of 109 relevant publications were found for evaluation in the context of our scoping review (see Figure 1: Flow chart).

Sixty-five relevant publications concerning masks were considered being within the scope of the content-related evaluation. These included 14 reviews and 2 meta-analyses from the primary research. For the quantitative evaluation, 44 presentations of nega-

tive effects from the years 2004 to 2020 were eligible. Thirty-one of these studies were experimental (70%), and 13 studies were data collection studies in the sense of simple observational studies, especially in the dermatological field (30%). The observed study parameters and significant results from these 44 publications ($p < 0.05$ or $n \geq 50\%$) were compiled in an overall display (Figure 2). Based on this data, a correlation analysis of the observed mask effects was performed. This included a correlation calculation of the recorded symptoms and physiological changes (for nominally scaled, dichotomous variables according to Fisher using R, R Foundation for Statistical Computing, Vienna, Austria, version 4.0.2).

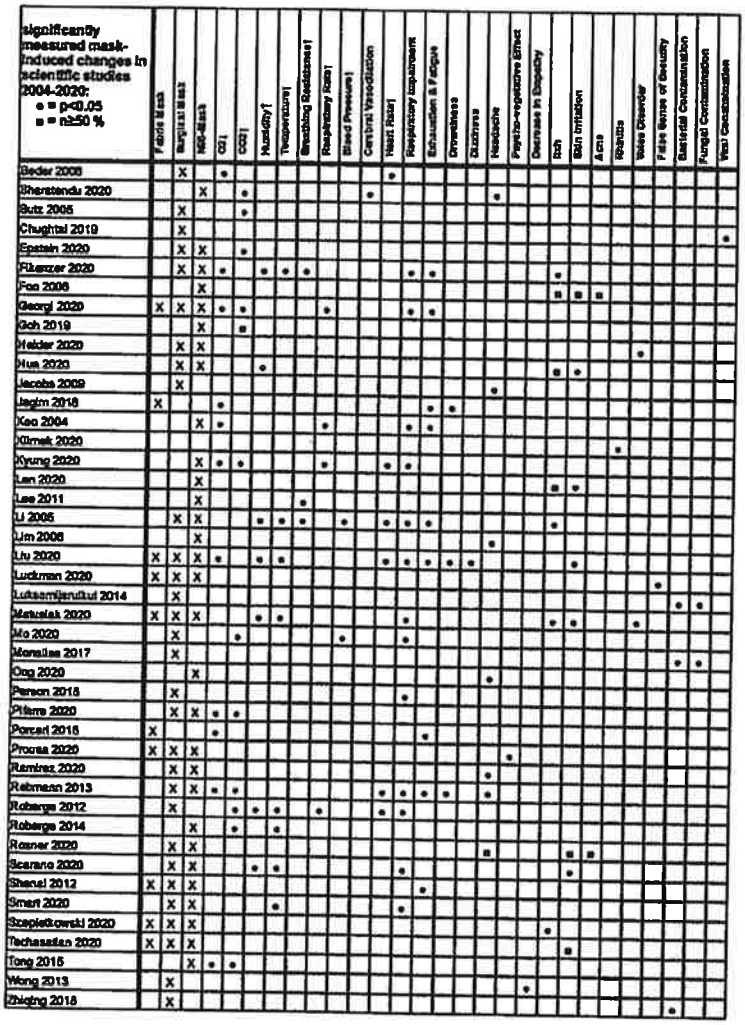

Figure 2. Overview including all 44 considered studies with quantified, significant adverse effects of masks (black dots and black rectangles). Not all studies examined each mentioned parameter, as focused or subject-related questions were often in the foreground. Gray fields correspond to a lack of coverage in the primary studies, white fields represent measured effects. We found an often combination of significant chemical, physical, physiological parameters and complaints. Drowsiness summarizes the symptom for any qualitative neurological deficits described in the scientific literature examined.

In addition, another 64 publications with a neighboring range of topics were consulted in connection with the mask effects we found. These included declarations, guidelines

and legal principles. In order to expand the amount of data for the discussion, we proceeded according to the "snowball principle" by locating citations of selected papers in the bibliographies and including them where appropriate.

Since the findings from the topics presented for discussion were to an unexpected degree subject-related, we decided to divide the results according to the fields of medicine. Of course, there are overlaps between the respective fields, which we point out in detail.

3. Results

A total of 65 scientific papers on masks qualified for a purely content-based evaluation. These included 14 reviews and two meta-analyses.

Of the mathematically evaluable, groundbreaking 44 papers with significant negative mask effects ($p < 0.05$ or $n \geq 50\%$), 22 were published in 2020 (50%), and 22 were published before the COVID-19 pandemic. Of these 44 publications, 31 (70%) were of experimental nature, and the remainder were observational studies (30%). Most of the publications in question were English (98%). Thirty papers referred to surgical masks (68%), 30 publications related to N95 masks (68%), and only 10 studies pertained to fabric masks (23%).

Despite the differences between the primary studies, we were able to demonstrate a statistically significant correlation in the quantitative analysis between the negative side effects of blood-oxygen depletion and fatigue in mask wearers with $p = 0.0454$.

In addition, we found a mathematically grouped common appearance of statistically significant confirmed effects of masks in the primary studies ($p < 0.05$ and $n \geq 50\%$) as shown in Figure 2. In nine of the 11 scientific papers (82%), we found a combined onset of N95 respiratory protection and carbon dioxide rise when wearing a mask. We found a similar result for the decrease in oxygen saturation and respiratory impairment with synchronous evidence in six of the nine relevant studies (67%). N95 masks were associated with headaches in six of the 10 studies (60%). For oxygen deprivation under N95 respiratory protectors, we found a common occurrence in eight of 11 primary studies (72%). Skin temperature rise under masks was associated with fatigue in 50% (three out of six primary studies). The dual occurrence of the physical parameter temperature rise and respiratory impairment was found in seven of the eight studies (88%). A combined occurrence of the physical parameters temperature rise and humidity/moisture under the mask was found in 100% within six of six studies, with significant readings of these parameters (Figure 2).

The literature review confirms that relevant, undesired medical, organ and organ system-related phenomena accompanied by wearing masks occur in the fields of internal medicine (at least 11 publications, Section 3.2). The list covers neurology (seven publications, Section 3.3), psychology (more than 10 publications, Section 3.4), psychiatry (three publications, Section 3.5), gynecology (three publications, Section 3.6), dermatology (at least 10 publications, Section 3.7), ENT medicine (four publications, Section 3.8), dentistry (one publication, Section 3.8), sports medicine (four publications, Section 3.9), sociology (more than five publications, Section 3.10), occupational medicine (more than 14 publications, Section 3.11), microbiology (at least four publications, Section 3.12), epidemiology (more than 16 publications, Section 3.13), and pediatrics (four publications, Section 3.14) as well as environmental medicine (four publications, Section 3.15).

We will present the general physiological effects as a basis for all disciplines. This will be followed by a description of the results from the different medical fields of expertise and closing off with pediatrics the final paragraph.

3.1. General Physiological and Pathophysiological Effects for the Wearer

As early as 2005, an experimental dissertation (randomized crossover study) demonstrated that wearing surgical masks in healthy medical personnel (15 subjects, 18–40 years old) leads to measurable physical effects with elevated transcutaneous carbon dioxide values after 30 min [13]. The role of dead space volume and CO_2 retention as a cause of the significant change ($p < 0.05$) in blood gases on the way to hypercapnia, which was still

within the limits, was discussed in this article. Masks expand the natural dead space (nose, throat, trachea, bronchi) outwards and beyond the mouth and nose.

An experimental increase in the dead space volume during breathing increases carbon dioxide (CO_2) retention at rest and under exertion and correspondingly the carbon dioxide partial pressure pCO_2 in the blood ($p < 0.05$) [14].

As well as addressing the increased rebreathing of carbon dioxide (CO_2) due to the dead space, scientists also debate the influence of the increased breathing resistance when using masks [15–17].

According to the scientific data, mask wearers as a whole show a striking frequency of typical, measurable, physiological changes associated with masks.

In a recent intervention study conducted on eight subjects, measurements of the gas content for oxygen (measured in O_2 Vol%) and carbon dioxide (measured in CO_2 ppm) in the air under a mask showed a lower oxygen availability even at rest than without a mask. A Multi-Rae gas analyzer was used for the measurements (RaeSystems®) (Sunnyvale, California CA, United States). At the time of the study, the device was the most advanced portable multivariant real-time gas analyzer. It is also used in rescue medicine and operational emergencies. The absolute concentration of oxygen (O_2 Vol%) in the air under the masks was significantly lower (minus 12.4 Vol% O_2 in absolute terms, statistically significant with $p < 0.001$) at 18.3% compared to 20.9% room air concentration. Simultaneously, a health-critical value of carbon dioxide concentration (CO_2 Vol%) increased by a factor of 30 compared to normal room air was measured (ppm with mask versus 464 ppm without mask, statistically significant with $p < 0.001$) [18].

These phenomena are responsible for a statistically significant increase in carbon dioxide (CO_2) blood content in mask wearers [19,20], on the one hand, measured transcutaneously via an increased $PtcCO_2$ value [15,17,19,21,22], on the other hand, via end-expiratory partial pressure of carbon dioxide ($PETCO_2$) [23,24] or, respectively, the arterial partial pressure of carbon dioxide ($PaCO_2$) [25].

In addition to the increase in the wearer's blood carbon dioxide (CO_2) levels ($p < 0.05$) [13,15,17,19,21–28], another consequence of masks that has often been experimentally proven is a statistically significant drop in blood oxygen saturation (SpO_2) ($p < 0.05$) [18,19,21,23,29–34]. A drop in blood oxygen partial pressure (PaO_2) with the effect of an accompanying increase in heart rate ($p < 0.05$) [15,23,29,30,34] as well as an increase in respiratory rate ($p < 0.05$) [15,21,23,35,36] have been proven.

A statistically significant measurable increase in pulse rate ($p < 0.05$) and decrease in oxygen saturation SpO_2 after the first ($p < 0.01$) and second hour ($p < 0.0001$) under a disposable mask (surgical mask) were reported by researchers in a mask intervention study they conducted on 53 employed neurosurgeons [30].

In another experimental study (comparative study), surgical and N95 masks caused a significant increase in heart rate ($p < 0.01$) as well as a corresponding feeling of exhaustion ($p < 0.05$). These symptoms were accompanied by a sensation of heat ($p < 0.0001$) and itching ($p < 0.01$) due to moisture penetration of the masks ($p < 0.0001$) in 10 healthy volunteers of both sexes after only 90 min of physical activity [35]. Moisture penetration was determined via sensors by evaluating logs (SCXI-1461, National Instruments, Austin, TX, USA).

These phenomena were reproduced in another experiment on 20 healthy subjects wearing surgical masks. The masked subjects showed statistically significant increases in heart rate ($p < 0.001$) and respiratory rate ($p < 0.02$) accompanied by a significant measurable increase in transcutaneous carbon dioxide $PtcCO_2$ ($p < 0.0006$). They also complained of breathing difficulties during the exercise [15].

The increased rebreathing of carbon dioxide (CO_2) from the enlarged dead space volume in mask wearers can reflectively trigger increased respiratory activity with increased muscular work as well as the resulting additional oxygen demand and oxygen consumption [17]. This is a reaction to pathological changes in the sense of an adaptation effect. A mask-induced drop in blood oxygen saturation value (SpO_2) [30] or the blood

oxygen partial pressure (PaO_2) [34] can in turn additionally intensify subjective chest complaints [25,34].

The documented mask-induced changes in blood gases towards hypercapnia (increased carbon dioxide/CO_2 blood levels) and hypoxia (decreased oxygen/O_2 blood levels) may result in additional nonphysical effects such as confusion, decreased thinking ability and disorientation [23,36–39], including overall impaired cognitive abilities and decrease in psychomotoric abilities [19,32,38–41]. This highlights the importance of changes in blood gas parameters (O_2 and CO_2) as a cause of clinically relevant psychological and neurological effects. The above parameters and effects (oxygen saturation, carbon dioxide content, cognitive abilities) were measured in a study on saturation sensors (Semi-Tec AG, Therwil, Switzerland), using a Borg Rating Scale, Frank Scale, Roberge Respirator Comfort Scale and Roberge Subjective Symptoms-during-Work Scale, as well as with a Likert scale [19]. In the other main study, conventional ECG, capnography and symptom questionnaires were used in measuring carbon dioxide levels, pulse and cognitive abilities [23]. Other physiological data collection was done with pulse oximeters (Allegiance, MCGaw, USA), subjective complaints were assessed with a 5-point Likert scale and motoric speed was recorded with linear-position transducers (Tendo-Fitrodyne, Sport Machins, Trencin, Slovakia) [32]. Some researchers used standardized, anonymized questionnaires to collect data on subjective complaints associated with masks [37].

In an experimental setting with different mask types (community, surgical, N95) a significant increase in heart rate ($p < 0.04$), a decrease in oxygen saturation SpO_2 ($p < 0.05$) with an increase in skin temperature under the mask (face) and difficulty of breathing ($p < 0.002$) were recorded in 12 healthy young subjects (students). In addition, the investigators observed dizziness ($p < 0.03$), listlessness ($p < 0.05$), impaired thinking ($p < 0.03$) and concentration problems ($p < 0.02$), which were also statistically significant when wearing masks [29].

According to other researchers and their publications, masks also interfere with temperature regulation, impair the field of vision and of non-verbal and verbal communication [15,17,19,36,37,42–45].

The above-mentioned measurable and qualitative physiological effects of masks can have implications in various areas of expertise in medicine.

It is known from pathology that not only supra-threshold stimuli exceeding normal limits have disease-relevant consequences. Subthreshold stimuli are also capable of causing pathological changes if the exposure time is long enough. Examples occur from the slightest air pollution by hydrogen sulfide resulting in respiratory problems (throat irritation, coughing, reduced absorption of oxygen) and neurological diseases (headaches, dizziness) [46]. Furthermore, subthreshold but prolonged exposure to nitrogen oxides and particulate matter is associated with an increased risk of asthma, hospitalization and higher overall mortality [47,48]. Low concentrations of pesticides are also associated with disease-relevant consequences for humans such as mutations, development of cancer and neurological disorders [49]. Likewise, the chronic subthreshold intake of arsenic is associated with an increased risk of cancer [50], subthreshold intake of cadmium with the promotion of heart failure [51], subthreshold intake of lead is associated with hypertension, renal metabolic disorders and cognitive impairment [52] or subthreshold intake of mercury with immune deficiency and neurological disorders [53]. Subliminal UV radiation exposure over long periods is also known to cause mutation-promoting carcinogenic effects (especially white skin cancer) [54].

The mask-induced adverse changes are relatively minor at first glance, but repeated exposure over longer periods in accordance with the above-mentioned pathogenetic principle is relevant. Long-term disease-relevant consequences of masks are to be expected. Insofar, the statistically significant results found in the studies with mathematically tangible differences between mask wearers and people without masks are clinically relevant. They give an indication that with correspondingly repeated and prolonged exposure to physical, chemical, biological, physiological and psychological conditions, some of which are

subliminal, but which are significantly shifted towards pathological areas, health-reducing changes and clinical pictures can develop such as high blood pressure and arteriosclerosis, including coronary heart disease (metabolic syndrome) as well as neurological diseases. For small increases in carbon dioxide in the inhaled air, this disease-promoting effect has been proven with the creation of headaches, irritation of the respiratory tract up to asthma as well as an increase in blood pressure and heart rate with vascular damage and, finally, neuropathological and cardiovascular consequences [38]. Even slightly but persistently increased heart rates encourage oxidative stress with endothelial dysfunction, via increased inflammatory messengers, and finally, the stimulation of arteriosclerosis of the blood vessels has been proven [55]. A similar effect with the stimulation of high blood pressure, cardiac dysfunction and damage to blood vessels supplying the brain is suggested for slightly increased breathing rates over long periods [56,57]. Masks are responsible for the aforementioned physiological changes with rises in inhaled carbon dioxide [18–28], small sustained increases in heart rate [15,23,29,30,35] and mild but sustained increases in respiratory rates [15,21,23,34,36].

For a better understanding of the side effects and dangers of masks presented in this literature review, it is possible to refer to well-known principles of respiratory physiology (Figure 3).

The average dead space volume during breathing in adults is approximately 150–180 mL and is significantly increased when wearing a mask covering the mouth and nose [58]. With an N95 mask, for example, the dead space volume of approximately 98–168 mL was determined in an experimental study [59]. This corresponds to a mask-related dead space increase of approximately 65 to 112% for adults and, thus, almost a doubling. At a respiratory rate of 12 per minute, the pendulum volume respiration with such a mask would, thus, be at least 2.9–3.8 L per minute. Therefore, the dead space amassed by the mask causes a relative reduction in the gas exchange volume available to the lungs per breath by 37% [60]. This largely explains the impairment of respiratory physiology reported in our work and the resulting side effects of all types of masks in everyday use in healthy and sick people (increase in respiratory rate, increase in heart rate, decrease in oxygen saturation, increase in carbon dioxide partial pressure, fatigue, headaches, dizziness, impaired thinking, etc.) [36,58].

In addition to the effect of increased dead space volume breathing, however, mask-related breathing resistance is also of exceptional importance (Figure 3) [23,36].

Experiments show an increase in airway resistance by a remarkable 126% on inhalation and 122% on exhalation with an N95 mask [60]. Experimental studies have also shown that moisturization of the mask (N95) increases the breathing resistance by a further 3% [61] and can, thus, increase the airway resistance up to 2.3 times the normal value.

This clearly shows the importance of the airway resistance of a mask. Here, the mask acts as a disturbance factor in breathing and makes the observed compensatory reactions with an increase in breathing frequency and simultaneous feeling of breathlessness plausible (increased work of the respiratory muscles). This extra strain due to the amplified work of breathing against bigger resistance caused by the masks also leads to intensified exhaustion with a rise in heart rate and increased CO_2 production. Fittingly, in our review of the studies on side effects of masks (Figure 2), we also found a percentage clustering of significant respiratory impairment and a significant drop in oxygen saturation (in about 75% of all study results).

In the evaluation of the primary papers, we also determined a statically significant correlation of the drop in oxygen saturation (SpO_2) and fatigue with a common occurrence in 58% of the mask use studies with significant results (Figure 2, $p < 0.05$).

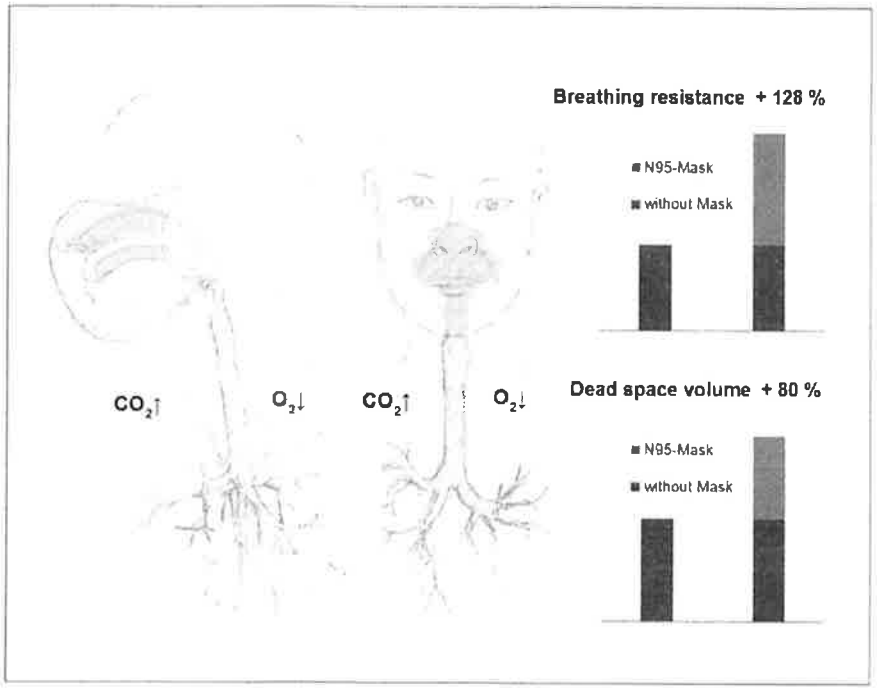

Figure 3. Pathophysiology of the mask (important physical and chemical effects): Illustration of the breathing resistance* and of the dead space volume of an N95 mask in an adult. When breathing, there is an overall significantly reduced possible gas exchange volume of the lungs of minus 37% caused by the mask (Lee 2011) [60] according to a decrease in breathing depth and volume due to the greater breathing resistance of plus128%* (exertion when inhaling greater than when exhaling) and due to the increased dead space volume of plus80%**, which does not participate directly in the gas exchange and is being only partially mixed with the environment. (* = averaged inspiration and expiration according to Lee 2011 [60] including moisture penetration according to Roberge 2010 [61], ** = averaged values according to Xu 2015 [59]).

3.2. *Internistic Side Effects and Dangers*

As early as 2012, an experiment showed that walking in the 20 masked subjects compared to the identical activity without masks significantly increased heart rates (average +9.4 beats per minute, $p < 0.001$) and breathing rates ($p < 0.02$). These physiological changes were accompanied by transcutaneous significantly measurable increased transcutaneous carbon dioxide ($PtcCO_2$) levels ($p < 0.0006$) as well as respiratory difficulties in the mask wearers compared to the control group [15].

In a recent experimental comparative study from 2020, 12 healthy volunteers under surgical masks as well as under N95 masks experienced measurable impairments in the measured lung function parameters as well as cardiopulmonary capacity (lower maximum blood lactate response) during moderate to heavy physical exertion compared to exertion without masks ($p < 0.001$) [31]. The mask-induced increased airway resistance led to increased respiratory work with increased oxygen consumption and demand, both of the respiratory muscles and the heart. Breathing was significantly impeded ($p < 0.001$) and participants reported mild pain. The scientists concluded from their results that the cardiac compensation of the pulmonary, mask-induced restrictions, which still functioned in healthy people, was probably no longer possible in patients with reduced cardiac output [31].

In another recent study, researchers tested fabric masks (community masks), surgical masks and FFP2/N95 masks in 26 healthy people during exercise on a cycle ergometer. All

masks also showed a measurable carbon dioxide (CO_2) retention ($PtcCO_2$) (statistically significant with $p < 0.001$) and, for N95 masks, a decrease in the oxygen saturation value SpO_2 (statistically significant at 75 and 100 W with $p < 0.02$ and $p < 0.005$, respectively). The clinical relevance of these changes was shown in an increase in breathing frequency with fabric masks ($p < 0.04$) as well as in the occurrence of the previously described mask-specific complaints such as a feeling of heat, shortness of breath and headaches. The stress perception was recorded on a Borg scale from 1 to 20. During physical exertion under an N95 mask, the group with masks showed a significant increase in the feeling of exhaustion compared to the group without with 14.6 versus 11.9 on the scale of 20. During the exposure, 14 of the 24 subjects wearing masks complained of shortness of breath (58%), four of headaches and two of a feeling of heat. Most of the complaints concerned FFP2 masks (72%) [21].

The aforementioned physiological and subjective physical effects of masks on healthy people at rest and under exertion [21,31] give an indication of the effect of masks on sick and elderly people even without exertion.

In an observational study of ten 20 to 50 year-old nurses wearing N95 masks during their shift work, side effects such as breathing difficulties ("I can't breathe"), feelings of exhaustion, headache ($p < 0.001$), drowsiness ($p < 0.001$) and a decrease in oxygen saturation SpO_2 ($p < 0.05$) as well as an increase in heart rate ($p < 0.001$) were statistically significant in association with an increase in obesity (BMI) [19]. The occurrence of symptoms under masks was also associated with older age (statistically significant correlation of fatigue and drowsiness with $p < 0.01$ each, nausea with $p < 0.05$, an increase in blood pressure with $p < 0.01$, headache with $p < 0.05$, breathing difficulties with $p < 0.001$) [19].

In an intervention study involving 97 patients with advanced chronic obstructive pulmonary disease (COPD) the respiratory rate, oxygen saturation and exhaled carbon dioxide equivalents (capnometry) changed unfavorably and significantly after the use of N95 masks (FFP2 equivalent) with an initial 10-minute rest and subsequent 6-minute walking. Seven patients discontinued the experiment due to serious complaints with a decrease in the oxygen saturation value SpO_2 and a pathological carbon dioxide (CO_2) retention as well as increased end-expiratory partial pressure of carbon dioxide ($PETCO_2$) [23]. In two patients, the $PETCO_2$ exceeded the normal limits and reached values of >50 mmHg. An FEV1 < 30% and a modified Medical Research Council (mMRC) Dyspnea Scale Score of ≥3, both indicators of advanced COPD, correlated with mask intolerance overall in this study. The most common symptom under mask was breathlessness at 86%. In the dropouts of the study, dizziness (57%) and headaches were also often recorded. In the mask-tolerant COPD patients, significant increases in heart rate, respiratory rate and end-expiratory carbon dioxide partial pressure $PETCO_2$ could be objectified even at rest, after only 10 min of mask-wearing ($p < 0.001$), accompanied by a decrease in oxygen saturation SpO_2 ($p < 0.001$) [23]. The results of this study with an evidence level IIa are indicative for COPD mask wearers.

In another retrospective comparative study on COPD and surgical masks, examiners were able to demonstrate statistically an increase in arterial partial pressure of carbon dioxide ($PaCO_2$) of approximately +8 mmHg ($p < 0.005$) and a concomitant mask-related increase in systolic blood pressure of +11 mmHg ($p < 0.02$) [25]. This increase is relevant in hypertensive patients, but also in healthy people with borderline blood pressure values as pathological value range triggered by mask-wearing can be induced.

In 39 hemodialysis patients with end-stage renal disease, a type N95 mask (FFP2 equivalent) caused a significant drop in blood oxygen partial pressure (PaO_2) in 70% of patients at rest (on hemodialysis) within only 4 h ($p = 0.006$). Despite a compensatory increased respiratory rate ($p < 0.001$), malaise with chest pain occurred ($p < 0.001$) and even resulted in hypoxemia (drop in oxygen below the normal limit) in 19% of the subjects [34]. The researchers concluded from their findings that elderly or patients with reduced cardiopulmonary function have a higher risk of developing a severe respiratory failure while wearing a mask [34].

In a review paper on the risks and benefits of masks worn during the COVID-19 crisis, other authors provide an equally critical assessment of mandatory mask use for patients with pneumonia, both with and without COVID-19 pneumonia disease [16].

3.3. Neurological Side Effects and Dangers

In a scientific evaluation of syncope in the operating theatre, 36 of 77 affected persons (47%) were associated with wearing a mask [62]. However, other factors could not be ruled out as contributory causes.

In their level III evidence review, neurologists from Israel, the UK and the USA state that a mask is unsuitable for epileptics because it can trigger hyperventilation [63]. The use of a mask significantly increases the respiratory rate by about plus 15 to 20% [15,21,23,34,64]. However, an increase in breathing frequency leading to hyperventilation is known to be used for provocation in the diagnosis of epilepsy and causes seizure-equivalent EEG changes in 80% of patients with generalized epilepsy and in up to 28% of focal epileptics [65].

Physicians from New York studied the effects of wearing masks of the surgical-type mask and N95 among medical personnel in a sample of 343 participants (surveyed using standardized, anonymized questionnaires). Wearing the masks caused detectable physical adverse effects such as impaired cognition (24% of wearers) and headaches in 71.4% of the participants. Of these, 28% persisted and required medication. Headache occurred in 15.2% under 1 h of wear, in 30.6% after 1 h of wear and in 29.7% after 3 h of wear. Thus, the effect intensified with increasing wearing time [37].

Confusion, disorientation and even drowsiness (Likert scale questionnaire) and reduced motoric abilities (measured with a linear position transducer) with reduced reactivity and overall impaired performance (measured with the Roberge Subjective Symptoms-during-Work Scale) as a result of mask use have also been documented in other studies [19,23,29,32,36,37].

The scientists explain these neurological impairments with a mask-induced latent drop in blood gas oxygen levels O_2 (towards hypoxia) or a latent increase in blood gas carbon dioxide levels CO_2 (towards hypercapnia) [36]. In view of the scientific data, this connection also appears to be indisputable [38–41].

In a mask experiment from 2020, significant impaired thinking ($p < 0.03$) and impaired concentration ($p < 0.02$) were found for all mask types used (fabric, surgical and N95 masks) after only 100 min of wearing the mask [29]. The thought disorders correlated significantly with a drop in oxygen saturation ($p < 0.001$) during mask use.

Initial headaches ($p < 0.05$) were experienced by up to 82% of 158, 21–35 year-old mask wearers in another study of N95 respiratory protection with one third (34%) experiencing headaches up to four times daily. Participants wore the mask for 18.3 days over a 30-day period with a mean of 5.9 h per day [66].

Significantly increased headache ($p < 0.05$) could be observed not only for N95 but also for surgical masks in participants of another observational study of health care workers [67].

In another study, the researchers classified 306 users with an average age of 43 years and wearing different types of masks, of whom 51% had an initial headache as a specific symptom related exclusively to increased surgical and N95 mask use (1 to 4 h, $p = 0.008$) [68].

Researchers from Singapore were able to demonstrate in a trial involving 154 healthy N95 health service mask wearers that a significant increase in mask-induced blood carbon dioxide levels (measured by end-expiratory partial pressure of carbon dioxide $PETCO_2$) and a measurably greater vasodilatation with an increase in cerebral artery flow in the cerebri media resulted. This was associated with headaches in the trial group ($p < 0.001$) [27].

According to the researchers, the aforementioned changes also contribute to headaches during the prolonged use of masks with a shift towards hypoxia and hypercapnia. Furthermore, stress and mechanical factors such as the irritation of cervical nerves in the neck and head area caused by the tight mask straps pressuring the nerve strands also contribute to headaches [66].

In the analysis of the primary studies, we were able to detect an association between the N95 mask and headaches. In six out of 10 studies, the significant headache appeared in conjunction with the N95 mask (60% of all studies, Figure 2).

3.4. *Psychological Side Effects and Dangers*

According to an experimental study, wearing surgical masks and N95 masks can also lead to a reduced quality of life owing to reduced cardiopulmonary capacity [31]. Masks, along with causing physiological changes and discomfort with progressive length of use, can also lead to significant discomfort ($p < 0.03$ to $p < 0.0001$) and a feeling of exhaustion ($p < 0.05$ to 0.0001) [69].

Besides the shift in blood gases towards hypercapnia (increase in CO_2) and hypoxia (decrease in O_2), detailed under general physiological effects (Section 3.1), masks also restrict the cognitive abilities of the individual (measured using a Likert scale survey) accompanied by a decline in psycho-motoric abilities and consequently a reduced responsiveness (measured using a linear position transducer) as well as an overall reduced performance capability (measured with the Roberge Subjective Symptoms-during-Work Scale) [29,32,38,39,41].

The mask also causes an impaired field of vision (especially affecting the ground and obstacles on the ground) and also presents an inhibition to habitual actions such as eating, drinking, touching, scratching and cleaning the otherwise uncovered part of the face, which is consciously and subconsciously perceived as a permanent disturbance, obstruction and restriction [36]. Wearing masks, thus, entails a feeling of deprivation of freedom and loss of autonomy and self-determination, which can lead to suppressed anger and subconscious constant distraction, especially as the wearing of masks is mostly dictated and ordered by others [70,71]. These perceived interferences of integrity, self-determination and autonomy, coupled with discomfort, often contribute to substantial distraction and may ultimately be combined with the physiologically mask-related decline in psychomotoric abilities, reduced responsiveness and an overall impaired cognitive performance. It leads to misjudging situations as well as delayed, incorrect and inappropriate behavior and a decline in the effectiveness of the mask wearer [36,37,39–41].

The use of masks for several hours often causes further detectable adverse effects such as headaches, local acne, mask-associated skin irritation, itching, sensations of heat and dampness, impairments and discomfort predominantly affecting the head and face [19,29,35–37,71–73]. However, the head and face are significant for well-being due to their large representation in the sensitive cerebral cortex (homunculus) [36].

According to a questionnaire survey, masks also frequently cause anxiety and psychovegetative stress reactions in children—as well as in adults—with an increase in psychosomatic and stress-related illnesses and depressive self-experience, reduced participation, social withdrawal and lowered health-related self-care [74]. Over 50% of the mask wearers studied had at least mild depressive feelings [74]. Additional fear-inducing and often exaggerated media coverage can further intensify this. A recent retrospective analysis of the general media in the context of the 2014 Ebola epidemic showed a scientific truth content of only 38% of all publicly published information [75]. Researchers classified a total of 28% of the information as provocative and polarizing and 42% as exaggerating risks. In addition, 72% of the media content aimed to stir up health-related negative feelings. The feeling of fear, combined with insecurity and the primal human need to belong [76], causes a social dynamic that seems partly unfounded from a medical and scientific point of view.

The mask, which originally served purely hygienic purpose, has been transformed into a symbol of conformity and pseudo-solidarity. The WHO, for example, lists the advantages of the use of masks by healthy people in public to include a potentially reduced stigmatization of mask wearers, a sense of contribution to preventing the spread of the virus and a reminder to comply with other measures [2].

3.5. Psychiatric Side Effects and Dangers

As explained earlier, masks can cause increased rebreathing with an accumulation of carbon dioxide in the wearer due to increased dead space volume [16–18,20] (Figure 3), with often statistically significant measurable elevated blood carbon dioxide (CO2) levels in sufferers [13,15,17,19–28] (Figure 2). However, changes that lead to hypercapnia are known to trigger panic attacks [77,78]. This makes the significantly measurable increase in CO_2 caused by wearing a mask clinically relevant.

Interestingly, breath provocation tests by inhaling CO_2 are used to differentiate anxiety states in panic disorders and premenstrual dysphoria from other psychiatric clinical pictures. Here, absolute concentrations of 5% CO_2 already suffice to trigger panic reactions within 15–16 min [77]. The normal exhaled air content of CO_2 is about 4%.

It is obvious from experimental studies on masked subjects that concentration changes in the respiratory gases in the above-mentioned range with values above 4% could occur during rebreathing with prolonged mask use [18,23].

The activation of the locus coeruleus by CO_2 is used to generate panic reactions via respiratory gases [78,79]. This is because the locus coeruleus is an important part of the system of vegetative noradrenergic neurons, a control center in the brainstem, which reacts to an appropriate stimulus and changes in the gas concentrations in the blood by releasing the stress hormone noradrenaline [78].

From the physiological, neurological and psychological side effects and dangers described above (Sections 3.1, 3.3 and 3.4), additional problems can be derived for the use of masks in psychiatric cases. People undergoing treatment for dementia, paranoid schizophrenia, personality disorders with anxiety and panic attacks, but also panic disorders with claustrophobic components, are difficult to reconcile with a mask requirement, because even small increases in CO_2 can cause and intensify panic attacks [44,77–79].

According to a psychiatric study, patients with moderate to severe dementia have no understanding of COVID-19 protection measures and have to be persuaded to wear masks constantly [80].

According to a comparative study, patients with schizophrenia have a lower acceptance of mask-wearing (54.9% agreement) than ordinary practice patients (61.6%) [81]. The extent to which mask-wearing can lead to an exacerbation of schizophrenia symptoms has not yet been researched in detail.

When wearing masks, confusion, impaired thinking, disorientation (standardized recording via special rating and Likert scales, $p < 0.05$) and in some cases a decrease in maximum speed and reaction time (measured with the linear-position transducer, $p < 0.05$) were observed [19,32,36,38–41]. Psychotropic drugs reduce psycho-motoric functions in psychiatric patients. This can become clinically relevant especially with regard to the further reduced ability to react and the additional increased susceptibility to accidents of such patients when wearing masks.

In order to avoid an unintentional CO_2-triggered anesthesia [39], fixed and medically sedated patients, without the possibility of continuous monitoring, should not be masked according to the criteria of the Centers for Disease Control and Prevention, USA (CDC). This is because of the possible CO_2 retention described above, as there is a risk of unconsciousness, aspiration and asphyxia [16,17,20,38,82,83].

3.6. Gynaecological Side Effects and Dangers

As a critical variable, a low blood carbon dioxide level in pregnant women is maintained via an increased respiratory minute volume, stimulated by progesterone [22]. For a pregnant woman and her unborn child, there is a metabolic need for a fetal–maternal carbon dioxide (CO_2) gradient. The mother's blood carbon dioxide level should always be lower than that of the unborn child in order to ensure the diffusion of CO_2 from the fetal blood into the maternal circulation via the placenta.

Therefore, mask-related phenomena described above (Sections 3.1 and 3.2), such as the measurable changes in respiratory physiology with increased breathing resistance,

increased dead space volume (Figure 3) and the retention of exhaled carbon dioxide (CO_2) are of importance. If CO_2 is increasingly rebreathed under masks, this manifestation could, even with subliminal carbon dioxide increases, act as a disturbing variable of the fetal–maternal CO_2 gradient increasing over time of exposure and, thus, develop clinical relevance, also with regard to a reduced compensation reserve of the expectant mothers [20,22,28].

In a comparative study, 22 pregnant women wearing N95 masks during 20 min of exercise showed significantly higher percutaneous CO_2 values, with average $PtcCO_2$ values of 33.3 mmHg compared to 31.3 mmHg than in 22 pregnant women without masks ($p = 0.04$) [22]. The heat sensation of the expectant mothers was also significantly increased with masks, with $p < 0.001$ [22].

Accordingly, in another intervention study, researchers demonstrated that breathing through an N95 mask (FFP2 equivalent) impeded gas exchange in 20 pregnant women at rest and during exercise, causing additional stress on their metabolic system [28]. Thus, under an N95 mask, 20 pregnant women showed a decrease in oxygen uptake capacity VO_2 of about 14% (statistically significant, $p = 0.013$) and a decrease in carbon dioxide output capacity VCO_2 of about 18% (statistically significant, $p = 0.001$). Corresponding significant changes in exhaled oxygen and carbon dioxide equivalents were also documented with increases in exhaled carbon dioxide ($FeCO_2$) ($p < 0.001$) and decreases in exhaled oxygen (FeO_2) ($p < 0.001$), which were explained by an altered metabolism due to respiratory mask obstruction [28].

In experiments with predominantly short mask application times, neither the mothers nor the fetuses showed statistically significant increases in heart rates or changes in respiratory rates and oxygen saturation values. However, the exact effects of prolonged mask use in pregnant women remain unclear overall. Therefore, in pregnant women, extended use of surgical and N95 masks is viewed critically [20].

In addition, it is unclear whether the substances contained in industrially manufactured masks that can be inhaled over longer periods of time (e.g., formaldehyde as an ingredient of the textile and thiram as an ingredient of the ear bands) are teratogenic [20,84].

3.7. *Dermatological Side Effects and Dangers*

Unlike garments worn over closed skin, masks cover body areas close to the mouth and nose, i.e., body parts that are involved with respiration.

Inevitably, this leads not only to a measurable temperature rise [15,44,85], but also to a severe increase in humidity due to condensation of the exhaled air, which in turn changes the natural skin milieu considerably of perioral and perinasal areas [36,61,82]. It also increases the redness, pH-value, fluid loss through the skin epithelium, increased hydration and sebum production measurably [73]. Preexisting skin diseases are not only perpetuated by these changes, but also exacerbated. In general, the skin becomes more susceptible to infections and acne.

The authors of an experimental study were able to prove a disturbed barrier function of the skin after only 4 h of wearing a mask in 20 healthy volunteers, both for surgical masks and for N95 masks [73]. In addition, germs (bacteria, fungi and viruses) accumulate on the outside and inside of the masks due to the warm and moist environment [86–89]. They can cause clinically relevant fungal, bacterial or viral infections. The unusual increase in the detection of rhinoviruses in the sentinel studies of the German Robert Koch Institute (RKI) from 2020 [90] could be another indication of this phenomenon.

In addition, a region of the skin that is not evolutionarily adapted to such stimuli is subjected to increased mechanical stress. All in all, the above-mentioned facts cause the unfavorable dermatological effects with mask related adverse skin reactions like acne, rashes on the face and itch symptoms [91].

A Chinese research group reported skin irritation and itching when using N95 masks among 542 test participants and also a correlation between the skin damage that occurred and the time of exposure (68.9% at $\leq$6 h/day and 81.7% at >6 h/day) [92].

A New York study evaluated in a random sample of 343 participants the effects of frequent wearing of surgical mask type and N95 masks among healthcare workers during the COVID-19 pandemic. Wearing the masks caused headache in 71.4% of participants, in addition to drowsiness in 23.6%, detectable skin damage in 51% and acne in 53% of mask users [37].

On the one hand, direct mechanical skin lesions occur on the nose and cheekbones due to shear force, especially when masks are frequently put on and taken off [37,92].

On the other hand, masks create an unnaturally moist and warm local skin environment [29,36,82]. In fact, scientists were able to demonstrate a significant increase in humidity and temperature in the covered facial area in another study in which the test individuals wore masks for one hour [85]. The relative humidity under the masks was measured with a sensor (Atmo-Tube, San Francisco, CA, USA). The sensation of humidity and temperature in the facial area is more crucial for well-being than other body regions [36,44]. This can increase discomfort under the masks. In addition, the increase in temperature favors bacterial optimization.

The pressure of the masks also causes an obstruction of the flow physiology of lymph and blood vessels in the face, with the consequence of increased disturbance of skin function [73] and ultimately also contributing to acne in up to 53% of all wearers and other skin irritations in up to 51% of all wearers [36,37,82].

Other researchers examined 322 participants with N95 masks in an observational study and detected acne in up to 59.6% of them, itching in 51.4% and redness in 35.8% as side effects [72].

In up to 19.6% (273) of the 1393 wearers of different masks (community masks, surgical, N95 masks), itching could be objectified in one study, in 9% even severely. An atopic predisposition (allergy tendency) correlated with the risk of itching. The length of use was significantly related to the risk of itching ($p < 0.0001$) [93].

In another dermatological study from 2020, 96.9% of 876 users of all mask types (community masks, surgical masks, N95 masks) confirmed adverse problems with a significant increase in itching (7.7%), accompanied by fogging-up of glasses (21.3%), flushing (21.3%), slurred speech (12.3%) and difficulty breathing (35.9%) ($p < 0.01$) [71].

Apart from an increased incidence of acne [37,72,91] under masks, contact eczema and urticaria [94] are generally described in connection with hypersensitivities to ingredients of the industrially manufactured masks (surgical mask and N95) such as formaldehyde (ingredient of the textile) and thiram (ingredient of the ear bands) [73,84]. The hazardous substance thiram, originally a pesticide and corrosive, is used in the rubber industry as a optimization accelerator. Formaldehyde is a biocide and carcinogen and is used as a disinfectant in the industry.

Even isolated permanent hyperpigmentation as a result of post-inflammatory or pigmented contact dermatitis has been described by dermatologists after prolonged mask use [72,91].

3.8. ENT and Dental Side Effects and Dangers

There are reports from dental communities about negative effects of masks and are accordingly titled "mask mouth" [95]. Provocation of gingivitis (inflammation of the gums), halitosis (bad breath), candidiasis (fungal infestation of the mucous membranes with Candida albicans) and cheilitis (inflammation of the lips), especially of the corners of the mouth, and even plaque and caries are attributed to the excessive and improper use of masks. The main trigger of the oral diseases mentioned is an increased dry mouth due to a reduced saliva flow and increased breathing through the open mouth under the mask. Mouth breathing causes surface dehydration and reduced salivary flow rate (SFR) [95]. Dry mouth is scientifically proven due to mask wear [29]. The bad habit of breathing through the open mouth while wearing a mask seems plausible because such breathing pattern compensates for the increased breathing resistance, especially when inhaling through the masks [60,61]. In turn, the outer skin moisture [71,73,85] with altered

skin flora, which has already been described under dermatological side effects (Section 3.7), is held responsible as an explanation for the inflammation of the lips and corners of the mouth (cheilitis) [95]. This clearly shows the disease-promoting reversal of the natural conditions caused by masks. The physiological internal moisture with external dryness in the oral cavity converts into internal dryness with external moisture.

ENT physicians recently discovered a new form of irritant rhinitis due to N95 mask use in 46 patients. They performed endoscopies and nasal irrigations on mask wearers, which were subsequently assessed pathologically. Clinical problems were recorded with standardized questionnaires. They found statistically significant evidence of mask-induced rhinitis and itching and swelling of the mucous membranes as well as increased sneezing ($p < 0.01$). Endoscopically, it showed an increased secretion and evidence of inhaled mask polypropylene fibers as the trigger of mucosal irritation [96].

In a study of 221 health care workers, ENT physicians objectified a voice disorder in 33% of mask users. The VHI-10 score of 1 to 10, which measures voice disorders, was on average 5.72 higher in these mask users (statistically significant with $p < 0.001$). The mask not only acted as an acoustic filter, provoking excessively loud speech, it also seems to trigger impaired vocal cord coordination because the mask compromises the pressure gradients required for undisturbed speech [43]. The researchers concluded from their findings that masks could pose a potential risk of triggering new voice disorders as well as exacerbating existing ones.

3.9. Sports Medicine Side Effects and Dangers

According to the literature, performance-enhancing effects of masks regarding cardiovascular optimization and improvement of oxygen uptake capacity cannot be proven.

For example, in an experimental reference study (12 subjects per group), the training mask that supposedly mimics altitude training (ETM: elevation training mask) only had training effects on the respiratory muscles. However, mask wearers showed significantly lower oxygen saturation values (SpO_2%) during exercise (SpO_2 of 94% for mask wearers versus 96% for mask-less, $p < 0.05$) [33], which can be explained by an increased dead space volume and increased resistance during breathing. The measured oxygen saturation values were significantly lower than the normal values in the group of mask wearers, which indicates a clinical relevance.

The proven adaptation effect of the respiratory muscles in healthy athletes [33] clearly suggests that masks have a disruptive effect on respiratory physiology.

In another intervention study on mask use in weightlifters, researchers documented statistically significant effects of reduced attention (questionnaire recording, Likert scale) and a slowed maximum speed of movement detectable by means of sensors (both significant at $p < 0.001$), leading the researchers to conclude that mask use in sport is not without risks. As a secondary finding, they also detected a significant decrease in oxygen saturation SpO_2 when performing special weight-lifting exercises ("back squats") in the mask group after only 1 min of exercise compared to the mask-free group ($p < 0.001$) [32]. The proven tendency of the masks to shift the chemical parameter oxygen saturation SpO_2 in a pathological direction (lower limit value 95%) may well have clinical relevance in untrained or sick individuals.

Sports medicine confirmed an increase in carbon dioxide (CO_2) retention, with an elevation in CO_2 partial pressure in the blood with larger respiratory dead space volumes [14].

In fact, dead space-induced CO_2 retention while wearing a mask during exercise was also experimentally proven. The effects of a short aerobic exercise under N95 masks were tested on 16 healthy volunteers. A significantly increased end-expiratory partial pressure of carbon dioxide ($PETCO_2$) with plus 8 mmHg ($p < 0.001$) was found [24]. The increase in blood carbon dioxide (CO_2) in the mask wearers under maximum load was plus 14% CO_2 for surgical masks and plus 23% CO_2 for N95 masks, an effect that may well have clinical relevance in the pre-diseased, elderly and children, as these values strongly approached the pathological range [24].

In an interesting endurance study with eight middle-aged subjects (19–66), the gas content for O_2 and CO_2 under the masks was determined before and after exercise. Even at rest, the oxygen availability under the masks was 13% lower than without the masks and the carbon dioxide (CO_2) concentration was 30 times higher. Under stress (Ruffier test), the oxygen concentration (% O_2) below the mask dropped significantly by a further 3.7%, while the carbon dioxide concentration (% CO_2) increased significantly by a further 20% (statistically significant with $p < 0.001$). Correspondingly, the oxygen saturation of the blood (SpO_2) of the test persons also decreased significantly from 97.6 to 92.1% ($p < 0.02$) [18]. The drop in the oxygen saturation value (SpO_2) to 92%, clearly below the normal limit of 95%, is to be classified as clinically relevant and detrimental to health.

These facts are an indication that the use of masks also triggers the effects described above leading to hypoxia and hypercapnia in sports. Accordingly, the WHO and Centers for Disease Control and Prevention, GA, USA (CDC) advise against wearing masks during physical exercise [82,97].

3.10. Social and Sociological Side Effects and Dangers

The results of a Chilean study with health care workers show that masks act like an acoustic filter and provoke excessively loud speech. This causes a voice disorder [43]. The increased volume of speech also contributes to increased aerosol production by the mask wearer [98]. These experimental data measured with the Aerodynamic Particle Sizer (APS, TSI, model 332, TSI Incorporated, Minnesota, MI, USA) are highly relevant.

Moreover, mask wearers are prevented from interacting normally in everyday life due to impaired clarity of speech [45], which tempts them to get closer to each other.

This results in a distorted prioritization in the general public, which counteracts the recommended measures associated with the COVID-19 pandemic. The WHO prioritizes social distancing and hand hygiene with moderate evidence and recommends wearing a mask with weak evidence, especially in situations where individuals are unable to maintain a physical distance of at least 1 m [3].

The disruption of non-verbal communication due to the loss of facial expression recognition under the mask can increase feelings of insecurity, discouragement and numbness as well as isolation, which can be extremely stressful for the mentally and hearing-impaired [16].

Experts point out that masks disrupt the basics of human communication (verbal and nonverbal). The limited facial recognition caused by masks leads to a suppression of emotional signals. Masks, therefore, disrupt social interaction, erasing the positive effect of smiles and laughter but at the same time greatly increasing the likelihood of misunderstandings because negative emotions are also less evident under masks [42].

A decrease in empathy perception through mask use with disruption of the doctor–patient relationship has already been scientifically proven on the basis of a randomized study (statistically significant, with $p = 0.04$) [99]. In this study, the Consultation Empathy Care Measury, the Patient Enablement Instrument (PEI) Score and a Satisfaction Rating Scale were assessed in 1030 patients. The 516 doctors, who wore masks throughout, conveyed reduced empathy towards the patients and, thus, nullified the positive health-promoting effects of a dynamic relationship. These results demonstrate a disruption of interpersonal interaction and relationship dynamics caused by masks.

The WHO guidance on the use of masks in children in the community, published in August 2020, points out that the benefits of mask use in children must be weighed up against the potential harms, including social and communicational concerns [100].

Fears that widespread pandemic measures will lead to dysfunctional social life with degraded social, cultural and psychological interactions have also been expressed by other experts [6–8,42].

3.11. Social and Occupational Medicine Side Effects and Hazards

In addition to mask-specific complaints such as a feeling of heat, dampness, shortness of breath and headache, various physiological phenomena were documented, such as the significant increase in heart and respiratory rate, the impairment of lung function parameters, the decrease in cardiopulmonary capacity (e.g., lower maximum blood lactate response) [15,19,21,23,29–31], as well as the changes in oxygen and carbon dioxide both in the end-expiratory and the air under the mask that was measured in the blood of the individuals [13,15,18,19,21–25,27–34]. The significant changes were measurable after only a few minutes of wearing a mask and in some cases reached magnitudes of minus 13% reduced O_2 concentration and 30-fold increased CO_2 concentration of the inhaled air under masks ($p < 0.001$) [18]. The changes observed were not only statistically significant, but also clinically relevant; the subjects also showed pathological oxygen saturation after exposure to masks ($p < 0.02$) [18].

Shortness of breath during light exertion (6 min walking) under surgical masks has been recorded with statistical significance in 44 healthy subjects in a prospective experimental intervention study ($p < 0.001$) [101]. Here, the complaints were assessed using a subjective, visual analogue scale.

In another study from 2011, all tested masks caused a significantly measurable increase in discomfort and a feeling of exhaustion in the 27 subjects during prolonged usage ($p < 0.0001$) [69].

These symptoms lead to additional stress for the occupational mask wearer and, thus, in relation to the feeling of exhaustion, contribute to the self-perpetuating vicious circle caused by the vegetative sympathetic activation, which further increases the respiratory and heart rate, blood pressure and increased sense of exhaustion [16,20,35,83].

Other studies showed that the psychological and physical effects of the masks can lead to an additional reduction in work performance (measured with the Roberge Subjective Symptoms-during-Work Scale, a Likert scale of 1–5) via increased feelings of fatigue, dissatisfaction and anxiety [58,102,103].

Wearing masks over a longer period of time also led to physiological and psychological impairments in other studies and, thus, reduced work performance [19,36,58,69]. In experiments on respiratory-protective equipment, an increase in the dead space volume by 350 mL leads to a reduction in the possible performance time by approx. −19%, furthermore to a decrease in breathing comfort by −18% (measured via a subjective rating scale) [58]. In addition, the time spent working and the flow of work is interrupted and reduced by putting on and taking off the masks and changing them. The reduced work performance has been recorded in the literature found as described above (especially in Sections 3.1 and 3.2) but has not been quantified further in detail [36,58].

Surgical mask type and N95 protective equipment frequently caused adverse effects in medical personnel such as headaches, breathing difficulties, acne, skin irritation, itching, decreased alertness, decreased mental performance and feelings of dampness and heat [19,29,37,71,85]. Subjective, work performance-reducing, mask-related impairments in users, measured with special survey scores and Likert scales, have also been described in other studies [15,21,27,32,35,43,66–68,72,96,99].

In Section 3.7 on dermatology, we already mentioned a paper that demonstrated a significant temperature increase of 1.9 °C on average (to over 34.5 °C) in the mask-covered facial area ($p < 0.05$) [85]. Due to the relatively larger representation in the sensitive cerebral cortex (homunculus), the temperature sensation in the face is more decisive for the feeling of well-being than other body regions [36,44]. The perception of discomfort when wearing a mask can, thus, be intensified. Interestingly, in our analysis, we found a combined occurrence of the physical variable temperature rise under the mask and the symptom respiratory impairment in seven of eight studies concerned, with a mutual significantly measured occurrence in 88%. We also detected a combined occurrence of significantly measured temperature rise under the mask and significantly measured fatigue in 50% of the relevant primary studies (three of six papers, Figure 2). These clustered associations of

temperature rise with symptoms of respiratory impairment and fatigue suggest a clinical relevance of the detected temperature rise under masks. In the worst case scenario, the effects mentioned can reinforce each other and lead to decompensation, especially in the presence of COPD, heart failure and respiratory insufficiency.

The sum of the disturbances and discomforts that can be caused by a mask also contributes to distraction (see also psychological impairment). These, in conjunction with a decrease in psycho-motoric skills, reduced responsiveness and overall impaired cognitive performance (all of which are pathophysiological effects of wearing a mask) [19,29,32,39–41] can lead to a failure to recognize hazards and, thus, to accidents or avoidable errors at work [19,36,37]. Of particular note here are mask-induced listlessness ($p < 0.05$), impaired thinking ($p < 0.05$) and concentration problems ($p < 0.02$) as measured by a Likert scale (1–5) [29]. Accordingly, occupational health regulations take action against such scenarios. The German Industrial Accident Insurance (DGUV) has precise and extensive regulations for respiratory protective equipment where they document the limitation of wearing time, levels of work intensity and defined instruction obligation [104].

The standards and norms prescribed in many countries regarding different types of masks to protect their workers are also significant from an occupational health point of view [105]. In Germany, for example, there are very strict safety specifications for masks from other international countries. These specify the requirements for the protection of the wearer [106]. All these standards and the accompanying certification procedures were increasingly relaxed with the introduction of mandatory masks for the general public. This meant that non-certified masks such as community masks were also used on a large scale in the work and school sectors for longer periods during the pandemic measures [107]. Most recently, in October 2020, the German Social Accident Insurance (DGUV) recommended the same usage time limits for community masks as for filtering half masks, namely, a maximum of three shifts of 120 min per day with recovery breaks of 30 min in between. In Germany, FFP2 (N95) masks must be worn for 75 min, followed by a 30-minute break. An additional suitability examination by specialized physicians is also obligatory and stipulated for occupationally used respirators [104].

3.12. *Microbiological Consequences for Wearer and Environment: Foreign/Self-Contamination*

Masks cause retention of moisture [61]. Poor filtration performance and incorrect use of surgical masks and community masks, as well as their frequent reuse, imply an increased risk of infection [108–110]. The warm and humid environment created by and in masks without the presence of protective mechanisms such as antibodies, the complement system, defense cells and pathogen-inhibiting and on a mucous membrane paves the way for unimpeded growth and, thus, an ideal growth and breeding ground for various pathogens such as bacteria and fungi [88] and also allows viruses to accumulate [87]. The warm and humid mask microclimate favors the accumulation of various germs on and underneath the masks [86], and the germ density is measurably proportional to the length of time the mask is worn. After only 2 h of wearing the mask, the pathogen density increases almost tenfold in experimental observation studies [87,89].

From a microbiological and epidemiological point of view, masks in everyday use pose a risk of contamination. This can occur as foreign contamination but also as self-contamination. On the one hand, germs are sucked in or attach themselves to the masks through convection currents. On the other hand, potential infectious agents from the nasopharynx accumulate excessively on both the outside and inside of the mask during breathing [5,88]. This is compounded by contact with contaminated hands. Since masks are constantly penetrated by germ-containing breath and the pathogen reproduction rate is higher outside mucous membranes, potential infectious pathogens accumulate excessively on the outside and inside of masks. On and in the masks, there are quite serious, potentially disease-causing bacteria and fungi such as *E. coli* (54% of all germs detected), Staphylococcus aureus (25% of all germs detected), Candida (6%), Klebsiella (5%), Enterococci (4%),

Pseudomonads (3%), Enterobacter (2%) and Micrococcus (1%) even detectable in large quantities [88].

In another microbiological study, the bacterium Staphylococcus aureus (57% of all bacteria detected) and the fungus Aspergillus (31% of all fungi detected) were found to be the dominant germs on 230 surgical masks examined [86].

After more than six hours of use, the following viruses were found in descending order on 148 masks worn by medical personnel: adenovirus, bocavirus, respiratory syncytial virus and influenza viruses [87].

From this aspect, it is also problematic that moisture distributes these potential pathogens in the form of tiny droplets via capillary action on and in the mask, whereby further proliferation in the sense of self- and foreign contamination by the aerosols can then occur internally and externally with every breath [35]. In this regard, it is also known from the literature that masks are responsible for a proportionally disproportionate production of fine particles in the environment and, surprisingly, much more so than in people without masks [98].

It was shown that all mask-wearing subjects released significantly more smaller particles of size 0.3–0.5 µm into the air than mask-less people, both when breathing, speaking and coughing (fabric, surgical, N95 masks, measured with the Aerodynamic Particle Sizer, APS, TS, model 3329) [98]. The increase in the detection of rhinoviruses in the sentinel studies of the German RKI from 2020 [90] could be a further indication of this phenomenon, as masks were consistently used by the general population in public spaces in that year.

3.13. Epidemiological Consequences

The possible side effects and dangers of masks described in this paper are based on studies of different types of masks. These include the professional masks of the surgical mask type and N95/KN95 (FFP2 equivalent) that are commonly used in everyday life, but also the community fabric masks that were initially used. In the case of N95, the N stands for National Institute for Occupational Safety and Health of the United States (NIOSH), and 95 indicates the 95 per cent filtering capacity for fine particles up to at least 0.3 µm [82].

A major risk of mask use in the general public is the creation of a false sense of security with regard to protection against viral infections, especially in the sense of a falsely assumed strong self-protection. Disregarding infection risks may not only neglect aspects of source control, but also result in other disadvantages. Although there are quite a few professional positive accounts of the widespread use of masks in the general populace [111], most of the serious and evident scientific reports conclude that the general obligation to wear masks conveys a false sense of security [4,5]. However, this leads to a neglect of those measures that, according to the WHO, have a higher level of effectiveness than mask-wearing: social distancing and hand hygiene [2,112]. Researchers were able to provide statistically significant evidence of a false sense of security and more risky behavior when wearing masks in an experimental setting [112].

Decision makers in many countries informed their citizens early on in the pandemic in March 2020 that people without symptoms should not use a medical mask, as this created a false sense of security [113]. The recommendation was ultimately changed in many countries. At least Germany pointed out that wearers of certain types of masks such as the common fabric masks (community masks) cannot rely on them to protect them or others from transmission of SARS-CoV-2 [114].

However, scientists not only complain about the lack of evidence for fabric masks in the scope of a pandemic [16,110], but also about the high permeability of fabric masks with particles and the potential risk of infection they pose [108,109]. Ordinary fabric masks with a 97% penetration for particle dimensions of $\geq$0.3 µm are in stark contrast to medical-type surgical masks with a 44% penetration. In contrast, the N95 mask has a penetration rate of less than 0.01% for particles $\geq$ 0.3 µm in the laboratory experiment [108,115].

For the clinical setting in hospitals and outpatient clinics, the WHO guidelines recommend only surgical masks for influenza viruses for the entire patient treatment except for the strongly aerosol-generating measures, for which finer filtering masks of the type N95 are suggested. However, the WHO's endorsement of specific mask types is not entirely evidence-based due to the lack of high-quality studies in the health sector [108,109,116,117].

In a laboratory experiment (evidence level IIa study), it was demonstrated that both surgical masks and N95 masks have deficits in protection against SARS-CoV-2 and influenza viruses using virus-free aerosols [118]. In this study, the FFP2-equivalent N95 mask performed significantly better in protection (8–12 times more effective) than the surgical mask, but neither mask type established reliable, hypothesis-generated protection against corona and influenza viruses. Both mask types could be penetrated unhindered by aerosol particles with a diameter of 0.08 to 0.2 µm. Both the SARS-CoV-2 pathogens with a size of 0.06 to 0.14 µm [119] and the influenza viruses with 0.08 to 0.12 µm are unfortunately well below the mask pore sizes [118].

The filtering capacity of the N95 mask up to 0.3 µm [82] is usually not achieved by surgical masks and community masks. However, aerosol droplets, which have a diameter of 0.09 to 3 µm in size, are supposed to serve as a transport medium for viruses. These also penetrate the medical masks by 40%. Often, there is also a poor fit between the face and the mask, which further impairs their function and safety [120]. The accumulation of aerosol droplets on the mask is problematic. Not only do they absorb nanoparticles such as viruses [6], but they also follow the airflow when inhaling and exhaling, causing them to be carried further. In addition, a physical decay process has been described for aerosol droplets at increasing temperatures, as also occurs under a mask [15,44,85]. This process can lead to a decrease in size of the fine water droplets up to the diameter of a virus [121,122]. The masks filter larger aerosol droplets but cannot retain viruses themselves and such smaller, potentially virus-containing aerosol droplets of less than 0.2 µm and hence cannot stop the spread of virus [123].

Similarly, in an in vivo comparative studies of N95 and surgical masks, there were no significant differences in influenza virus infection rates [124,125]. Although this contrasts with encouraging in vitro laboratory results with virus-free aerosols under non-natural conditions, even with fabric masks [126], it should be noted that under natural in-vivo conditions, the promising filtration functions of fabric masks based on electrostatic effects also rapidly diminish under increasing humidity [127]. A Swiss textile lab test of various masks available on the market to the general public recently confirmed that most mask types filter aerosols insufficiently. For all but one of the eight reusable fabric mask types tested, the filtration efficacy according to EN149 was always less than 70% for particles of 1 µm in size. For disposable masks, only half of all eight mask types tested were efficient enough at filtering to retain 70% of particles 1 µm in size [128].

A recent experimental study even demonstrated that all mask-wearing people (surgical, N95, fabric masks) release significantly and proportionately smaller particles of size 0.3 to 0.5 µm into the air than mask-less people, both when breathing, speaking and coughing [98]. According to this, the masks act like nebulizers and contribute to the production of very fine aerosols. Smaller particles, however, spread faster and further than large ones for physical reasons. Of particular interest in this experimental reference study was the finding that a test subject wearing a single-layer fabric mask was also able to release a total of 384% more particles (of various sizes) when breathing than a person without [98].

It is not only the aforementioned functional weaknesses of the masks themselves that lead to problems, but also their use. This increases the risk of a false sense of security. According to the literature, mistakes are made by both healthcare workers and lay people when using masks as hygienically correct mask use is by no means intuitive. Overall, 65% of healthcare professionals and as many as 78% of the general population, use masks incorrectly [116]. With both surgical masks and N95 masks, adherence to the rules of use is impaired and not adequately followed due to reduced wearability with heat discomfort and skin irritation [29,35,116,129]. This is exacerbated by the accumulation of carbon dioxide

due to the dead space (especially under the N95 masks) with the resulting headaches described [19,27,37,66–68,83]. Increased heart rate, itching and feelings of dampness [15,29,30,35,71] also lead to reduced safety and quality during use (see also social and occupational health side effects and hazards). For this reason, (everyday) masks are even considered a general risk for infection in the general population, which does not come close to imitating the strict hygiene rules of hospitals and doctors' offices: the supposed safety, thus, becomes a safety risk itself [5].

In a meta-analysis of evidence level Ia commissioned by the WHO, no effect of masks in the context of influenza virus pandemic prevention could be demonstrated [130]. In 14 randomized controlled trials, no reduction in the transmission of laboratory-confirmed influenza infections was shown. Due to the similar size and distribution pathways of the virus species (influenza and Corona, see above), the data can also be transferred to SARS-CoV-2 [118]. Nevertheless, a combination of occasional mask-wearing with adequate hand-washing caused a slight reduction in infections for influenza in one study [131]. However, since no separation of hand hygiene and masks was achieved in this study, the protective effect can rather be attributed to hand hygiene in view of the aforementioned data [131].

A recently published large prospective Danish comparative study comparing mask wearers and non-mask wearers in terms of their infection rates with SARS-CoV2 could not demonstrate any statistically significant differences between the groups [132].

3.14. *Paediatric Side Effects and Hazards*

Children are particularly vulnerable and may be more likely to receive inappropriate treatment or additional harm. It can be assumed that the potential adverse mask effects described for adults are all the more valid for children (see Section 3.1 to Section 3.13: physiological internal, neurological, psychological, psychiatric, dermatological, ENT, dental, sociological, occupational and social medical, microbiological and epidemiological impairments and also Figures 2 and 3).

Special attention must be paid to the respiration of children, which represents a critical and vulnerable physiological variable due to higher oxygen demand, increased hypoxia susceptibility of the CNS, lower respiratory reserve, smaller airways with a stronger increase in resistance when the lumen is narrowed. The diving reflex caused by stimulating the nose and upper lip can cause respiratory arrest to bradycardia in the event of oxygen deficiency.

The masks currently used for children are exclusively adult masks manufactured in smaller geometric dimensions and had neither been specially tested nor approved for this purpose [133].

In an experimental British research study, the masks frequently led to feelings of heat ($p < 0.0001$) and breathing problems ($p < 0.03$) in 100 school children between 8 and 11 years of age especially during physical exertion, which is why the protective equipment was taken off by 24% of the children during physical activity [133]. The exclusion criteria for this mask experiment were lung disease, cardiovascular impairment and claustrophobia [133].

Scientists from Singapore were able to demonstrate in their level Ib study published in the renowned journal "nature" that 106 children aged between 7 and 14 years who wore FFP2 masks for only 5 min showed an increase in the inspiratory and expiratory CO_2 levels, indicating disturbed respiratory physiology [26].

However, a disturbed respiratory physiology in children can have long-term disease-relevant consequences. Slightly elevated CO_2 levels are known to increase heart rate, blood pressure, headache, fatigue and concentration disorders [38].

Accordingly, the following conditions were listed as exclusion criteria for mask use [26]: any cardiopulmonary disease including but not limited to: asthma, bronchitis, cystic fibrosis, congenital heart disease, emphysema; any condition that may be aggravated by physical exertion, including but not limited to: exercise-induced asthma; lower respiratory tract infections (pneumonia, bronchitis within the last 2 weeks), anxiety disorders,

diabetes, hypertension or epilepsy/attack disorder; any physical disability due to medical, orthopedic or neuromuscular disease; any acute upper respiratory illness or symptomatic rhinitis (nasal obstruction, runny nose or sneezing); any condition with deformity that affects the fit of the mask (e.g., increased facial hair, craniofacial deformities, etc.).

It is also important to emphasize the possible effects of masks in neurological diseases, as described earlier (Section 3.3).

Both masks and face shields caused fear in 46% of children (37 out of 80) in a scientific study. If children are given the choice of whether the doctor examining them should wear a mask they reject this in 49% of the cases. Along with their parents, the children prefer the practitioner to wear a face visor (statistically significant with $p < 0.0001$) [134].

A recent observational study of tens of thousands of mask-wearing children in Germany helped the investigators objectify complaints of headaches (53%), difficulty concentrating (50%), joylessness (49%), learning difficulties (38%) and fatigue in 37% of the 25,930 children evaluated. Of the children observed, 25% had new onset anxiety and even nightmares [135]. In children, the threat scenarios generated by the environment are further maintained via masks, in some cases, even further intensified, and in this way, existing stress is intensified (presence of subconscious fears) [16,35,136,137].

This can in turn lead to an increase in psychosomatic and stress-related illnesses [74,75]. For example, according to an evaluation, 60% of mask wearers showed stress levels of the highest grade 10 on a scale of 1 to a maximum of 10. Less than 10% of the mask wearers surveyed had a stress level lower than 8 out of a possible 10 [74].

As children are considered a special group, the WHO also issued a separate guideline on the use of masks in children in the community in August 2020, explicitly advising policy makers and national authorities, given the limited evidence, that the benefits of mask use in children must be weighed up against the potential harms associated with mask use. This includes feasibility and discomfort, as well as social and communication concerns [100].

According to experts, masks block the foundation of human communication and the exchange of emotions and not only hinder learning but deprive children of the positive effects of smiling, laughing and emotional mimicry [42]. The effectiveness of masks in children as a viral protection is controversial, and there is a lack of evidence for their widespread use in children; this is also addressed in more detail by the scientists of the German University of Bremen in their thesis paper 2.0 and 3.0 [138].

3.15. Effects on the Environment

According to WHO estimates of a demand of 89 million masks per month, their global production will continue to increase under the Corona pandemic [139]. Due to the composition of, e.g., disposable surgical masks with polymers such as polypropylene, polyurethane, polyacrylonitrile, polystyrene, polycarbonate, polyethylene and polyester [140], an increasing global challenge, also from an environmental point of view, can be expected, especially outside Europe, in the absence of recycling and disposal strategies [139]. The aforementioned single use polymers have been identified as a significant source of plastic and plastic particles for the pollution of all water cycles up to the marine environment [141].

A significant health hazard factor is contributed by mask waste in the form of microplastics after decomposition into the food chain. Likewise, contaminated macroscopic disposable mask waste—especially before microscopic decay—represents a widespread medium for microbes (protozoa, bacteria, viruses, fungi) in terms of invasive pathogens [86–89,142]. Proper disposal of bio-contaminated everyday mask material is insufficiently regulated even in western countries.

4. Discussion

The potential drastic and undesirable effects found in multidisciplinary areas illustrate the general scope of global decisions on masks in general public in the light of combating the pandemic. According to the literature found, there are clear, scientifically recorded adverse effects for the mask wearer, both on a psychological and on a social and physical level.

Neither higher level institutions such as the WHO or the European Centre for Disease Prevention and Control (ECDC) nor national ones, such as the Centers for Disease Control and Prevention, GA, USA (CDC) or the German RKI, substantiate with sound scientific data a positive effect of masks in the public (in terms of a reduced rate of spread of COVID-19 in the population) [2,4,5].

Contrary to the scientifically established standard of evidence-based medicine, national and international health authorities have issued their theoretical assessments on the masks in public places, even though the compulsory wearing of masks gives a deceptive feeling of safety [5,112,143].

From an infection epidemiological point of view, masks in everyday use offer the risk of self-contamination by the wearer from both inside and outside, including via contaminated hands [5,16,88]. In addition, masks are soaked by exhaled air, which potentially accumulates infectious agents from the nasopharynx and also from the ambient air on the outside and inside of the mask. In particular, serious infection-causing bacteria and fungi should be mentioned here [86,88,89], but also viruses [87]. The unusual increase in the detection of rhinoviruses in the sentinel studies of the German RKI from 2020 [90] could be an indication of this phenomenon. Clarification through further investigations would therefore be desirable.

Masks, when used by the general public, are considered by scientists to pose a risk of infection because the standardized hygiene rules of hospitals cannot be followed by the general public [5]. On top of that, mask wearers (surgical, N95, fabric masks) exhale relatively smaller particles (size 0.3 to 0.5 µm) than mask-less people and the louder speech under masks further amplifies this increased fine aerosol production by the mask wearer (nebulizer effect) [98].

The history of modern times shows that already in the influenza pandemics of 1918–1919, 1957–58, 1968, 2002, in SARS 2004–2005 as well as with the influenza in 2009, masks in everyday use could not achieve the hoped-for success in the fight against viral infection scenarios [67,144]. The experiences led to scientific studies describing as early as 2009 that masks do not show any significant effect with regard to viruses in an everyday scenario [129,145]. Even later, scientists and institutions rated the masks as unsuitable to protect the user safely from viral respiratory infections [137,146,147]. Even in hospital use, surgical masks lack strong evidence of protection against viruses [67].

Originally born out of the useful knowledge of protecting wounds from surgeons' breath and predominantly bacterial droplet contamination [144,148,149], the mask has been visibly misused with largely incorrect popular everyday use, particularly in Asia in recent years [150]. Significantly, the sociologist Beck described the mask as a cosmetic of risk as early as 1992 [151]. Unfortunately, the mask is inherent in a vicious circle: strictly speaking, it only protects symbolically and at the same time represents the fear of infection. This phenomenon is reinforced by the collective fear mongering, which is constantly nurtured by main stream media [137].

Nowadays, the mask represents a kind of psychological support for the general population during the virus pandemic, promising them additional anxiety-reduced freedom of movement. The recommendation to use masks in the sense of "source control" not out of self-protection but out of "altruism" [152] is also very popular with the regulators as well as the population of many countries. The WHO's recommendation of the mask in the current pandemic is not only a purely infectiological approach, but is also clear on the possible advantages for healthy people in the general public. In particular, a reduced potential stigmatization of mask wearers, the feeling of a contribution made to preventing the spread of the virus, as well as the reminder to adhere to other measures are mentioned [2].

It should not go unmentioned that very recent data suggest that the detection of SARS-CoV-2 infection does not seem to be directly related to popular mask use. The groups examined in a retrospective comparative study (infected with SARS-CoV-2 and not infected) did not differ in their habit of using masks: approximately 70% of the subjects in both groups always wore masks and another 14.4% of them frequently [143].

In a Danish prospective study on mask-wearing carried out on about 6000 participants and published in 2020, scientists found no statistically significant difference in the rates of SARS-CoV-2 infection when comparing the group of 3030 mask wearers with the 2994 mask-less participants in the study ($p = 0.38$) [132].

Indeed, in the case of viral infections, masks appear to be not only less effective than expected, but also not free of undesirable biological, chemical, physical and psychological side effects [67]. Accordingly, some experts claim that well-intentioned unprofessionalism can be quite dangerous [6].

The dermatological colleagues were the first to describe common adverse effects of mask-wearing in larger collectives. Simple, direct physical, chemical and biological effects of the masks with increases in temperature, humidity and mechanical irritation caused acne in up to 60% of wearers [37,71–73,85]. Other significantly documented consequences were eczema, skin damage and overall impaired skin barrier function [37,72,73].

These direct effects of mask use are an important pointer to further detrimental effects affecting other organ systems.

In our work, we have identified scientifically validated and numerous statistically significant adverse effects of masks in various fields of medicine, especially with regard to a disruptive influence on the highly complex process of breathing and negative effects on the respiratory physiology and gas metabolism of the body (see Figures 2 and 3). The respiratory physiology and gas exchange play a key role in maintaining a health-sustaining balance in the human body [136,153]. According to the studies we found, a dead space volume that is almost doubled by wearing a mask and a more than doubled breathing resistance (Figure 3) [59–61] lead to a rebreathing of carbon dioxide with every breathing cycle [16–18,39,83] with—in healthy people mostly—a subthreshold but, in sick people, a partly pathological increase in the carbon dioxide partial pressure ($PaCO_2$) in the blood [25,34,58]. According to the primary studies found, these changes contribute reflexively to an increase in respiratory frequency and depth [21,23,34,36] with a corresponding increase in the work of the respiratory muscles via physiological feedback mechanisms [31,36]. Thus, it is not, as initially assumed, purely positive training through mask use. This often increases the subliminal drop in oxygen saturation SpO_2 in the blood [23,28–30,32], which is already reduced by increased dead space volume and increased breathing resistance [18,31].

The overall possible resulting measurable drop in oxygen saturation O_2 of the blood on the one hand [18,23,28–30,32] and the increase in carbon dioxide (CO_2) on the other [13,15,19,21–28] contribute to an increased noradrenergic stress response, with heart rate increase [29,30,35] and respiratory rate increase [15,21,23,34], in some cases also to a significant blood pressure increase [25,35].

In panic-prone individuals, stress-inducing noradrenergic sympathetic activation can be partly directly mediated via the carbon dioxide (CO_2) mechanism at the locus coeruleus in the brainstem [39,78,79,153], but also in the usual way via chemo-sensitive neurons of the nucleus solitarius in the medulla [136,154]. The nucleus solitarius [136] is located in the deepest part of the brainstem, a gateway to neuronal respiratory and circulatory control [154]. A decreased oxygen (O_2) blood level there causes the activation of the sympathetic axis via chemoreceptors in the carotids [155,156].

Even subthreshold changes in blood gases such as those provoked when wearing a mask cause reactions in these control centers in the central nervous system. Masks, therefore, trigger direct reactions in important control centers of the affected brain via the slightest changes in oxygen and carbon dioxide in the blood of the wearer [136,154,155].

A link between disturbed breathing and cardiorespiratory diseases such as hypertension, sleep apnea and metabolic syndrome has been scientifically proven [56,57]. Interestingly, decreased oxygen/O_2 blood levels and also increased carbon dioxide/CO_2 blood levels are considered the main triggers for the sympathetic stress response [38,136]. The aforementioned chemo-sensitive neurons of the nucleus solitarius in the medulla are considered to be the main responsible control centers [136,154,155]. Clinical effects of prolonged mask-wearing would, thus, be a conceivable intensification of chronic stress re-

actions and negative influences on the metabolism leading towards a metabolic syndrome. The mask studies we found show that such disease-relevant respiratory gas changes (O_2 and CO_2) [38,136] are already achieved by wearing a mask [13,15,18,19,21–34].

A connection between hypoxia, sympathetic reactions and leptin release is scientifically known [136].

Additionally important is the connection of breathing with the influence on other bodily functions [56,57], including the psyche with the generation of positive emotions and drive [153]. The latest findings from neuro-psychobiological research indicate that respiration is not only a function regulated by physical variables to control them (feedback mechanism), but rather independently influences higher-level brain centers and, thus, also helps to shape psychological and other bodily functions and reactions [153,157,158]. Since masks impede the wearer's breathing and accelerate it, they work completely against the principles of health-promoting breathing [56,57] used in holistic medicine and yoga. According to recent research, undisturbed breathing is essential for happiness and healthy drive [157,159], but masks work against this.

The result of significant changes in blood gases in the direction of hypoxia (drop in oxygen saturation) and hypercapnia (increase in carbon dioxide concentration) through masks, thus, has the potential to have a clinically relevant influence on the human organism even without exceeding normal limits.

According to the latest scientific findings, blood-gas shifts towards hypoxia and hypercapnia not only have an influence on the described immediate, psychological and physiological reactions on a macroscopic and microscopic level, but additionally on gene expression and metabolism on a molecular cellular level in many different body cells. Through this, the drastic disruptive intervention of masks in the physiology of the body also becomes clear down to the cellular level, e.g., in the activation of hypoxia-induced factor (HIF) through both hypercapnia and hypoxia-like effects [160]. HIF is a transcription factor that regulates cellular oxygen supply and activates signaling pathways relevant to adaptive responses. e.g., HIF inhibits stem cells, promotes tumor cell growth and inflammatory processes [160]. Based on the hypoxia- and hypercapnia-promoting effects of masks, which have been comprehensively described for the first time in our study, potential disruptive influences down to the intracellular level (HIF-a) can be assumed, especially through the prolonged and excessive use of masks. Thus, in addition to the vegetative chronic stress reaction in mask wearers, which is channeled via brain centers, there is also likely to be an adverse influence on metabolism at the cellular level. With the prospect of continued mask use in everyday life, this also opens up an interesting field of research for the future.

The fact that prolonged exposure to latently elevated CO_2 levels and unfavorable breathing air compositions has disease-promoting effects was recognized early on. As early as 1983, the WHO described "Sick Building Syndrome" (SBS) as a condition in which people living indoors experienced acute disease-relevant effects that increased with time of their stay, without specific causes or diseases [161,162]. The syndrome affects people who spend most of their time indoors, often with subliminally elevated CO_2 levels, and are prone to symptoms such as increased heart rate, rise in blood pressure, headaches, fatigue and difficulty concentrating [38,162]. Some of the complaints described in the mask studies we found (Figure 2) are surprisingly similar to those of Sick Building Syndrome [161]. Temperature, carbon dioxide content of the air, headaches, dizziness, drowsiness and itching also play a role in Sick Building Syndrome. On the one hand, masks could themselves be responsible for effects such as those described for Sick Building Syndrome when used for a longer period of time. On the other hand, they could additionally intensify these effects when worn in air-conditioned buildings, especially when masks are mandatory indoors. Nevertheless, there was a tendency towards higher systolic blood pressure values in mask wearers in some studies [21,31,34], but statistical significance was only found in two studies [25,35]. However, we found more relevant and significant evidence of heart

rate increase, headache, fatigue and concentration problems associated with mask wearers (Figure 2) indicating the clinical relevance of wearing masks.

According to the scientific results and findings, masks have measurably harmful effects not only on healthy people, but also on sick people and their relevance is likely to increase with the duration of use [69]. Further research is needed here to shed light on the long-term consequences of widespread mask use with subthreshold hypoxia and hypercapnia in the general population, also regarding possible exacerbating effects on cardiorespiratory lifestyle diseases such as hypertension, sleep apnea and metabolic syndrome. The already often elevated blood carbon dioxide (CO_2) levels in overweight people, sleep apnea patients and patients with overlap-COPD could possibly increase even further with everyday masks. Not only a high body mass index (BMI) but also sleep apnea are associated with hypercapnia during the day in these patients (even without masks) [19,163]. For such patients, hypercapnia means an increase in the risk of serious diseases with increased morbidity, which could then be further increased by excessive mask use [18,38].

The hypercapnia-induced effects of sympathetic stress activation are even cycle phase-dependent in women. Controlled by a progesterone mechanism, the sympathetic reaction, measured by increased blood pressure in the luteal phase, is considerably stronger [164]. This may also result in different sensitivities for healthy and sick women to undesirable effects masks have, which are related to an increase in carbon dioxide (CO_2).

In our review, negative physical and psychological changes caused by masks could be objectified even in younger and healthy individuals.

The physical and chemical parameters did not exceed the normal values in most cases but were statistically significantly measurable ($p < 0.05$) tending towards pathological ranges. They were accompanied by physical impairments (see Figure 2). It is well known that subthreshold stimuli are capable of causing pathological changes when exposed to them for a long time: not only a single high dose of a disturbance, but also a chronically persistent, subthreshold exposure to it often leads to illness [38,46–48,50–54]. The scientifically repeatedly measurable physical and chemical mask effects were often accompanied by typical subjective complaints and pathophysiological phenomena. The fact that these frequently occur simultaneously and together indicates a syndrome under masks.

Figure 2 sums up the significant mask-dependent physiological, psychological, somatic and general pathological changes and their frequent occurrence together is striking. Within the framework of the quantitative evaluation of the experimental studies, we were actually able to prove a statistically significant correlation of the observed side effects of fatigue and oxygen depletion under mask use with $p < 0.05$. In addition, we found a frequent, simultaneous and joint occurrence of further undesirable effects in the scientific studies (Figure 2). Statistically significant associations of such co-occurring, adverse effects have already been described in primary studies [21,29]. We detected a combined occurrence of the physical parameter temperature rise under the mask with the symptom respiratory impairment in seven of the nine studies concerned (88%). We found a similar result for the decrease in oxygen saturation under mask and the symptom respiratory impairment with a simultaneous detection in six of the eight studies concerned (67%). We detected a combined occurrence of carbon dioxide rise under N95 mask use in nine of the 11 scientific papers (82%). We found a similar result for oxygen drop under N95 mask use with simultaneous co-occurrence in eight of 11 primary papers (72%). The use of N95 masks was also associated with headache in six of the 10 primary studies concerned (60%). A combined occurrence of the physical parameters temperature rise and humidity under masks was even found 100% within six of the six studies with significant measurements of these parameters (Figure 2).

Since the symptoms were described in combination in mask wearers and were not observed in isolation in the majority of cases, we refer to them as general Mask-Induced Exhaustion Syndrome (MIES) because of the consistent presentation in numerous papers from different disciplines. These include the following, predominantly statistically significantly

($p < 0.05$) proven pathophysiological changes and subjective complaints, which often occur in combination as described above (see also Section 3.1 to Section 3.11, Figures 2–4):

- Increase in dead space volume [22,24,58,59] (Figure 3, Sections 3.1 and 3.2).
- Increase in breathing resistance [31,35,61,118] (Figure 3, Figure 2: Column 8).
- Increase in blood carbon dioxide [13,15,19,21–28] (Figure 2: Column 5).
- Decrease in blood oxygen saturation [18,19,21,23,28–34] (Figure 2: Column 4).
- Increase in heart rate [15,19,23,29,30,35] (Figure 2: Column 12).
- Decrease in cardiopulmonary capacity [31] (Section 3.2).
- Feeling of exhaustion [15,19,21,29,31–35,69] (Figure 2: Column 14).
- Increase in respiratory rate [15,21,23,34] (Figure 2: Column 9).
- Difficulty breathing and shortness of breath [15,19,21,23,25,29,31,34,35,71,85,101,133] (Figure 2: Column 13).
- Headache [19,27,37,66–68,83] (Figure 2: Column 17).
- Dizziness [23,29] (Figure 2: Column 16).
- Feeling of dampness and heat [15,16,22,29,31,35,85,133] (Figure 2: Column 7).
- Drowsiness (qualitative neurological deficits) [19,29,32,36,37] (Figure 2: Column 15).
- Decrease in empathy perception [99] (Figure 2: Column 19).
- Impaired skin barrier function with acne, itching and skin lesions [37,72,73] (Figure 2: Column 20–22).

It can be deduced from the results that the effects described in healthy people are all more pronounced in sick people, since their compensatory mechanisms, depending on the severity of the illness, are reduced or even exhausted. Some existing studies on and with patients with measurable pathological effects of the masks support this assumption [19,23,25,34]. In most scientific studies, the exposure time to masks in the context of the measurements/investigations was significantly less (in relation to the total wearing and duration of use) than is expected of the general public under the current pandemic regulations and ordinances.

The exposure time limits are little observed or knowingly disregarded in many areas today as already mentioned in Section 3.11 on occupational medicine. The above facts allow the conclusion that the described negative effects of masks, especially in some of our patients and the very elderly, may well be more severe and adverse with prolonged use than presented in some mask studies.

From a doctor's viewpoint, it may also be difficult to advise children and adults who, due to social pressure (to wear a mask) and the desire to feel they belong, suppress their own needs and concerns until the effects of masks have a noticeable negative impact on their health [76]. Nevertheless, the use of masks should be stopped immediately at the latest when shortness of breath, dizziness or vertigo occur [23,25]. From this aspect, it seems sensible for decision makers and authorities to provide information, to define instruction obligations and offer appropriate training for employers, teachers and other persons who have a supervisory or caregiving duty. Knowledge about first aid measures could also be refreshed and expanded accordingly in this regard.

Elderly, high-risk patients with lung disease, cardiac patients, pregnant women or stroke patients are advised to consult a physician to discuss the safety of an N95 mask as their lung volume or cardiopulmonary performance may be reduced [23]. A correlation between age and the occurrence of the aforementioned symptoms while wearing a mask has been statistically proven [19]. Patients with reduced cardiopulmonary function are at increased risk of developing serious respiratory failure with mask use according to the referenced literature [34]. Without the possibility of continuous medical monitoring, it can be concluded that they should not wear masks without close monitoring. The American Asthma and Allergy Society has already advised caution in the use of masks with regard to the COVID-19 pandemic for people with moderate and severe lung disease [165]. Since the severely overweight, sleep apnea patients and overlap-COPD sufferers are known to be prone to hypercapnia, they also represent a risk group for serious adverse health effects under extensive mask use [163]. This is because the potential of masks to produce additional

CO_2 retention may not only have a disruptive effect on the blood gases and respiratory physiology of sufferers, but may also lead to further serious adverse health effects in the long term. Interestingly, in an animal experiment an increase in CO_2 with hypercapnia leads to contraction of smooth airway muscles with constriction of bronchi [166]. This effect could explain the observed pulmonary decompensations of patients with lung disease under masks (Section 3.2) [23,34].

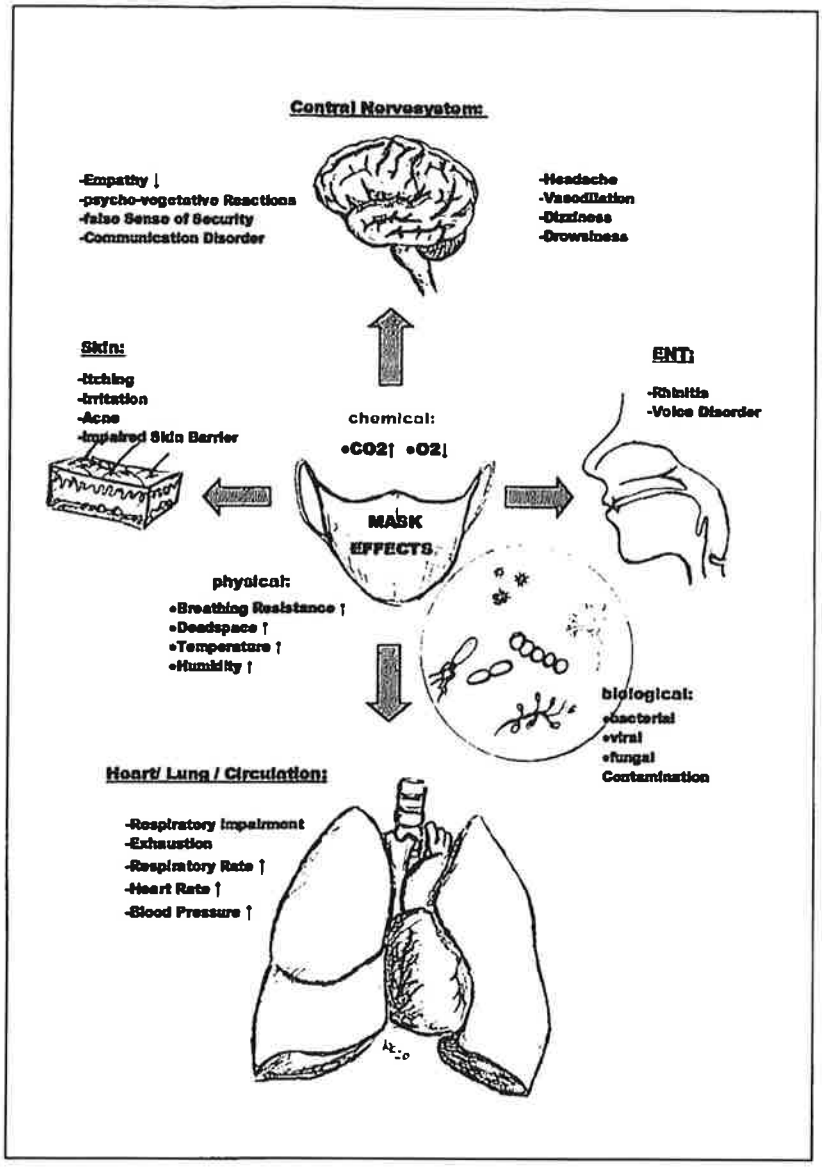

Figure 4. Unfavorable mask effects as components of Mask-Induced Exhaustion Syndrome (MIES). The chemical, physical and biological effects, as well as the organ system consequences mentioned, are all documented with statistically significant results in the scientific literature found (Figure 2). The term drowsiness is used here to summarize any qualitative neurological deficits described in the examined scientific literature.

Patients with renal insufficiency requiring dialysis are, according to the literature available, further candidates for a possible exemption from the mask requirement [34].

According to the criteria of the Centers for Disease Control and Prevention, GA, USA (CDC), sick and helpless people who cannot remove a mask on their own should be exempted from the mask requirement [82].

Since it can be assumed that children react even more sensitively to masks, the literature suggests that masks are a contraindication for children with epilepsies (hyperventilation as a trigger for seizures) [63]. In the field of pediatrics, special attention should also be paid to the mask symptoms described under psychological, psychiatric and sociological effects with possible triggering of panic attacks by CO_2 rebreathing in the case of predisposition and also reinforcement of claustrophobic fears [77–79,167]. The mask-related disturbance of verbal [43,45,71] and non-verbal communication and, thus, of social interaction is particularly serious for children. Masks restrict social interaction and block positive perceptions (smiling and laughing) and emotional mimicry [42]. The proven mask-induced mild to moderate cognitive impairment with impaired thinking, decreased attention and dizziness [19,23,29,32,36,37,39–41,69], as well as the psychological and neurological effects [135], should be additionally taken into account when masks are compulsory at school and in the vicinity of both public and non-public transport, also regarding the possibility of an increased risk of accidents (see also occupational health side effects and hazards) [19,29,32,36,37]. The exclusion criteria mentioned in pediatric studies on masks (see pediatric impairments, Section 3.14) [26,133] should also apply to an exclusion of these children from the general mask obligation in accordance with the scientific findings for the protection of the sick children concerned. The long-term sociological, psychological and educational consequences of a comprehensive masking requirement extended to schools are also unpredictable with regard to the psychological and physical development of healthy children [42,135]. Interestingly, according to the Corona Thesis Paper of the University of Bremen children "are infected less often, they become ill less often, the lethality is close to zero, and they also pass on the infection less often", according to the Thesis Paper 2.0 of the German University of Bremen on page 6 [138]. Studies conducted under real-life conditions with outcome endpoints showing hardly any infections, hardly any morbidity, hardly any mortality and only low contagiousness in children are clearly in the majority, according to Thesis Paper 3.0 of the German University of Bremen [138]. A recent German observational study (5600 reporting pediatricians) also showed a surprisingly low incidence of COVID-19 disease in children [168]. The infection of adults with SARS-CoV-2 by children has been considered in only one suspected case, but could not be proven with certainty, since the parents also had numerous contacts and exposure factors for viral infections due to their occupation. In this case, the circulating headlines in the public media that children contribute more to the incidence of infection are to be regarded as anecdotal.

In pregnant women, the use of masks during exertion or at rest over long periods of time is to be regarded as critical as little research has been done on this [20]. If there is clear scientific evidence of increased dead space ventilation with possible accumulation of CO_2 in the mother's blood, the use of masks by pregnant women for more than 1 h, as well as under physical stress, should be avoided in order to protect the unborn child [20,22]. The hypercapnia-promoting masks could act as a confounder of the fetal/maternal CO_2 gradient in this case (Section 3.6) [20,22,28].

According to the literature cited in the Section 3.5 on psychiatric side effects (personality disorders with anxiety and panic attacks, claustrophobia, dementia and schizophrenia), masking should only be done, if at all, with careful consideration of the advantages and disadvantages. Attention should be paid to possible provocation of the number and severity of panic attacks [77–79].

In patients with headaches, a worsening of symptoms can be expected with prolonged mask use (see also Section 3.3., neurological side effects) [27,66–68]. As a result of the increase in blood carbon dioxide (CO_2) when the mask is used, vasodilatation occurs in the central nervous system and the pulsation of the blood vessels decreases [27]. In this connection, it is also interesting to note radiological experiments that demonstrate an increase in brain volume under subthreshold, but still within normal limits of CO_2 increase

in the blood by means of structural MRI. The blood carbon dioxide increase was produced in seven subjects via rebreathing with resulting median carbon dioxide concentration of 42 mmHg and an interquartile range of 39.44 mmHg, corresponding to only a subthreshold increase given the normal values of 32–45 mmHg. In the experiment, there was a significant increase in brain parenchymal volume measurable under increased arterial CO_2 levels ($p < 0.02$), with a concomitant decrease in CSF spaces ($p < 0.04$), entirely in accordance with the Monroe–Kelly doctrine, according to which the total volume within the skull always remains the same. The authors interpreted the increase in brain volume as an expression of an increase in blood volume due to a CO_2 increase-induced dilation of the cerebral vessels [169]. The consequences of such equally subthreshold carbon dioxide (CO_2) increases even under masks [13,15,18,19,22,23,25] are unclear for people with pathological changes inside the skull (aneurysms, tumors, etc.) with associated vascular changes [27] and brain volume shifts [169] especially due to longer exposure while wearing a mask, but could be of great relevance due to the blood gas-related volume shifts that take place.

In view of the increased dead space volume, the long-term and increased accumulation and rebreathing of other respiratory air components apart from CO_2 is also unexplained, both in children and in old and sick people. Exhaled air contains over 250 substances, including irritant or toxic gases such as nitrogen oxides (NO), hydrogen sulfide (H2S), isoprene and acetone [170]. For nitrogen oxides [47] and hydrogen sulfide [46], pathological effects relevant to disease have been described in environmental medicine even at a low but chronic exposure [46–48]. Among the volatile organic compounds in exhaled air, acetone and isoprene dominate in terms of quantity, but allyl methyl sulfide, propionic acid and ethanol (some of bacterial origin) should also be mentioned [171]. Whether such substances also react chemically with each other underneath masks and in the dead space volume created by masks (Figure 3), and with the mask tissue itself, and in what quantities these and possible reaction products are rebreathed, has not yet been clarified. In addition to the blood gas changes described above (O_2 drop and CO_2 rise), these effects could also play a role with regard to undesirable mask effects. Further research is needed here and is of particular interest in the case of prolonged and ubiquitous use of masks.

The WHO sees the integration of individual companies and communities that produce their own fabric masks as a potential social and economic benefit. Due to the global shortage of surgical masks and personal protective equipment, it sees this as a source of income and points out that the reuse of fabric masks can reduce costs and waste and contribute to sustainability [2]. In addition to the question of certification procedures for such fabric masks, it should also be mentioned that due to the extensive mask obligation, textile (artificial) substances in the form of micro- and nanoparticles, some of which cannot be degraded in the body, are chronically absorbed into the body through inhalation to an unusual extent. In the case of medical masks, disposable polymers such as polypropylene, polyurethane, polyacrylonitrile, polystyrene, polycarbonate, polyethylene and polyester should be mentioned [140]. ENT physicians have already been able to detect such particles in the nasal mucosa of mask wearers with mucosal reactions in the sense of a foreign body reaction with rhinitis [96]. In the case of community masks, other substances from the textile industry are likely to be added to those mentioned above. The body will try to absorb these substances through macrophages and scavenger cells in the respiratory tract and alveoli as part of a foreign body reaction, whereby toxin release and corresponding local and generalized reactions may occur in an unsuccessful attempt to break them down [172]. Extensive respiratory protection in permanent long-term use (24/7), at least from a theoretical point of view, also potentially carries the risk of leading to a mask-related pulmonary [47] or even generalized disorder, as is already known from textile workers chronically exposed to organic dusts in the Third World (byssinosis) [172].

For the general public, from a scientific angle, it is necessary to draw on the long-standing knowledge of respiratory protection in occupational medicine in order to protect children in particular from harm caused by uncertified masks and improper use.

The universal undefined and extended mask requirement—without taking into account multiple predispositions and susceptibilities—contradicts the claim of an increasingly important individualized medicine with a focus on the unique characteristics of each individual [173].

A systematic review on the topic of masks is necessary according to the results of our scoping review. The primary studies often showed weaknesses in operationalization, especially in the evaluation of cognitive and neuropsychological parameters. Computerized test procedures will be useful here in the future. Mask research should also set itself the future goal of investigating and defining subgroups for whom respiratory protection use is particularly risky.

5. Limitations

Our approach with a focus on negative effects is in line with Villalonga-Olives and Kawachi [12]. With the help of such selective questioning in the sense of dialectics, new insights can be gained that might otherwise have remained hidden. Our literature search focused on adverse negative effects of masks, in particular to point out risks especially for certain patient groups. Therefore, publications presenting only positive effects of masks were not considered in this review.

For a compilation of studies with harmless results when using masks, reference must, therefore, be made to reviews with a different research objective, whereby attention must be paid to possible conflicts of interest there. Some of the studies excluded by us lacking negative effects have shown methodological weaknesses (small, non-uniform experimental groups, missing control group even without masks due to corona constraints, etc.) [174]. In other words, if no negative concomitant effects were described in publications, it does not necessarily mean that masks have exclusively positive effects. It is quite possible that negative effects were simply not mentioned in the literature and the number of negative effects may well be higher than our review suggests.

We only searched one database, so the number of papers on negative mask effects may be higher than we reported.

In order to be able to describe characteristic effects for each mask type even more extensively, we did not have enough scientific data on the respective special designs of the masks. There is still a great need for research in this area due to the current pandemic situation with extensive mandatory masking.

In addition, the experiments evaluated in this paper do not always have uniform measurement parameters and study variables and, depending on the study, take into account the effect of masks at rest or under stress with subjects having different health conditions. Figure 2, therefore, represents a compromise. The results of the primary studies on mask use partially showed no natural variation in parameters, but often showed such clear correlations between symptoms and physiological changes, so that a statistical correlation analysis was not always necessary. We found a statistically significant correlation of oxygen deprivation and fatigue in 58% of the studies ($p < 0.05$). A statistically significant correlation evidence for other parameters has been previously demonstrated in primary studies [21,29].

The most commonly used personal particulate matter protective equipment in the COVID-19 pandemic is the N95 mask [23]. Due to its characteristics (better filtering function, but greater airway resistance and more dead space volume than other masks), the N95 mask is able to highlight negative effects of such protective equipment more clearly than others (Figure 3). Therefore, a relatively frequent consideration and evaluation of N95 masks within the studies found (30 of the 44 quantitatively evaluated studies, 68%) is even advantageous within the framework of our research question. Nevertheless, it remains to be noted that the community masks sold on the market are increasingly similar to the protective equipment that has been better investigated in scientific studies, such as surgical masks and N95 masks, since numerous manufacturers and users of community masks are striving to approximate the professional standard (surgical mask, N95/FFP2). Recent

study results on community masks indicate similar effects for respiratory physiology as described for medical masks: in a recent publication, fabric masks (community masks) also provoked a measurable increase in carbon dioxide $PtcCO_2$ in wearers during exertion and came very close to surgical masks in this effect [21].

Most of the studies cited in our paper included only short observation and application periods (mask-wearing durations investigated ranged from 5 min [26] to 12 h [19]. In only one study, a maximum observation period of an estimated 2-month period was chosen [37]. Therefore, the actual negative effects of masks over a longer application period might be more pronounced than presented in our work.

6. Conclusions

On the one hand, the advocacy of an extended mask requirement remains predominantly theoretical and can only be sustained with individual case reports, plausibility arguments based on model calculations and promising in vitro laboratory tests. Moreover, recent studies on SARS-CoV-2 show both a significantly lower infectivity [175] and a significantly lower case mortality than previously assumed, as it could be calculated that the median corrected infection fatality rate (IFR) was 0.10% in locations with a lower than average global COVID-19 population mortality rate [176]. In early October 2020, the WHO also publicly announced that projections show COVID-19 to be fatal for approximately 0.14% of those who become ill—compared to 0.10% for endemic influenza—again a figure far lower than expected [177].

On the other hand, the side effects of masks are clinically relevant.

In our work, we focused exclusively on the undesirable and negative side effects that can be produced by masks. Valid significant evidence of combined mask-related changes were objectified ($p < 0.05$, $n \geq 50\%$), and we found a clustered and common occurrence of the different adverse effects within the respective studies with significantly measured effects (Figure 2). We were able to demonstrate a statistically significant correlation of the observed adverse effect of hypoxia and the symptom of fatigue with $p < 0.05$ in the quantitative evaluation of the primary studies. Our review of the literature shows that both healthy and sick people can experience Mask-Induced Exhaustion Syndrome (MIES), with typical changes and symptoms that are often observed in combination, such as an increase in breathing dead space volume [22,24,58,59], increase in breathing resistance [31,35,60,61], increase in blood carbon dioxide [13,15,17,19,21–30,35], decrease in blood oxygen saturation [18,19,21,23,28–34], increase in heart rate [23,29,30,35], increase in blood pressure [25,35], decrease in cardiopulmonary capacity [31], increase in respiratory rate [15,21,23,34,36], shortness of breath and difficulty breathing [15,17,19,21,23,25,29,31,34,35,60,71,85,101,133], headache [19,27,29,37,66–68,71,83], dizziness [23,29], feeling hot and clammy [17,22,29,31,35,44,71,85,133], decreased ability to concentrate [29], decreased ability to think [36,37], drowsiness [19,29,32,36,37], decrease in empathy perception [99], impaired skin barrier function [37,72,73] with itching [31,35,67,71–73,91–93], acne, skin lesions and irritation [37,72,73], overall perceived fatigue and exhaustion [15,19,21,29,31,32,34,35,69] (Figures 2–4).

Wearing masks does not consistently cause clinical deviations from the norm of physiological parameters, but according to the scientific literature, a long-term pathological consequence with clinical relevance is to be expected owing to a longer-lasting effect with a subliminal impact and significant shift in the pathological direction. For changes that do not exceed normal values, but are persistently recurring, such as an increase in blood carbon dioxide [38,160], an increase in heart rate [55] or an increase in respiratory rate [56,57], which have been documented while wearing a mask [13,15,17,19,21–30,34,35] (Figure 2), a long-term generation of high blood pressure [25,35], arteriosclerosis and coronary heart disease and of neurological diseases is scientifically obvious [38,55–57,160]. This pathogenetic damage principle with a chronic low-dose exposure with long-term effect, which leads to disease or disease-relevant conditions, has already been extensively studied and described in many areas of environmental medicine [38,46–54]. Extended

mask-wearing would have the potential, according to the facts and correlations we have found, to cause a chronic sympathetic stress response induced by blood gas modifications and controlled by brain centers. This in turn induces and triggers immune suppression and metabolic syndrome with cardiovascular and neurological diseases.

We not only found evidence in the reviewed mask literature of potential long-term effects, but also evidence of an increase in direct short-term effects with increased mask-wearing time in terms of cumulative effects for: carbon dioxide retention, drowsiness, headache, feeling of exhaustion, skin irritation (redness, itching) and microbiological contamination (germ colonization) [19,22,37,66,68,69,89,91,92].

Overall, the exact frequency of the described symptom constellation MIES in the mask-using populace remains unclear and cannot be estimated due to insufficient data.

Theoretically, the mask-induced effects of the drop in blood gas oxygen and increase in carbon dioxide extend to the cellular level with induction of the transcription factor HIF (hypoxia-induced factor) and increased inflammatory and cancer-promoting effects [160] and can, thus, also have a negative influence on pre-existing clinical pictures.

In any case, the MIES potentially triggered by masks (Figures 3 and 4) contrasts with the WHO definition of health: "health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." [178].

All the scientific facts found in our work expand the knowledge base for a differentiated view of the mask debate. This gain can be relevant for decision makers who have to deal with the issue of mandatory mask use during the pandemic under constant review of proportionality as well as for physicians who can advise their patients more appropriately on this basis. For certain diseases, taking into account the literature found in this study, it is also necessary for the attending physician to weigh up the benefits and risks with regard to a mask obligation. With an overall strictly scientific consideration, a recommendation for mask exemption can become justifiable within the framework of a medical appraisal (Figure 5).

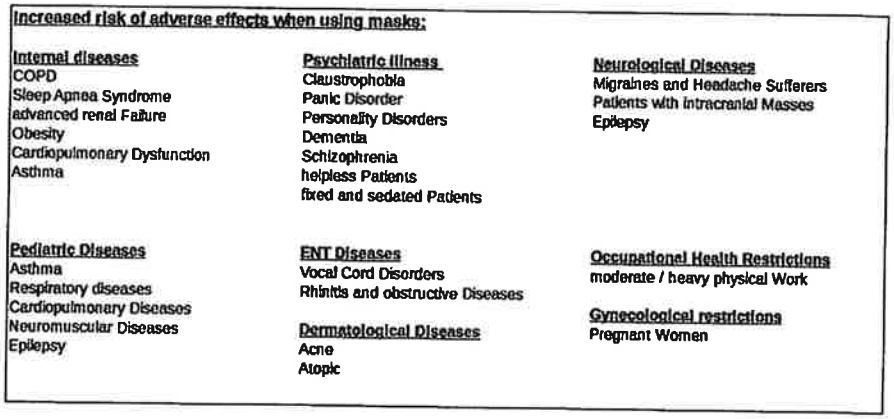

Figure 5. Diseases/predispositions with significant risks, according to the literature found, when using masks. Indications for weighing up medical mask exemption certificates.

In addition to protecting the health of their patients, doctors should also base their actions on the guiding principle of the 1948 Geneva Declaration, as revised in 2017. According to this, every doctor vows to put the health and dignity of his patient first and, even under threat, not to use his medical knowledge to violate human rights and civil liberties [9]. Within the framework of these findings, we, therefore, propagate an explicitly medically judicious, legally compliant action in consideration of scientific factual reality [2,4,5,16,130,132,143,175–177] against a predominantly assumption-led claim to a general effectiveness of masks, always taking into account possible unwanted individual ef-

fects for the patient and mask wearer concerned, entirely in accordance with the principles of evidence-based medicine and the ethical guidelines of a physician.

The results of the present literature review could help to include mask-wearing in the differential diagnostic pathophysiological cause consideration of every physician when corresponding symptoms are present (MIES, Figure 4). In this way, the physician can draw on an initial complaints catalogue that may be associated with mask-wearing (Figure 2) and also exclude certain diseases from the general mask requirement (Figure 5).

For scientists, the prospect of continued mask use in everyday life suggests areas for further research. In our view, further research is particularly desirable in the gynecological (fetal and embryonic) and pediatric fields, as children are a vulnerable group that would face the longest and, thus, most profound consequences of a potentially risky mask use. Basic research at the cellular level regarding mask-induced triggering of the transcription factor HIF with potential promotion of immunosuppression and carcinogenicity also appears to be useful under this circumstance. Our scoping review shows the need for a systematic review.

The described mask-related changes in respiratory physiology can have an adverse effect on the wearer's blood gases sub-clinically and in some cases also clinically manifest and, therefore, have a negative effect on the basis of all aerobic life, external and internal respiration, with an influence on a wide variety of organ systems and metabolic processes with physical, psychological and social consequences for the individual human being.

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MEMORANDUM

TO: BOARD OF CITY COMMISSIONERS

FROM: ARLETTE PRESTON, LIAISON COMMISSIONER-HEALTH DEPT.

DATE: FEBRUARY 16, 2022

SUBJECT: REPORT ON MASK UTILIZATION AS A PANDEMIC MITIGATION STRATEGY

A recent request was made for the Health Department to report on the utilization of masks during the pandemic. I have requested the experts in the Health Department and our community to report to the City Commission on the topic.

Masking as a Pandemic Strategy, will be introduced by Desi Fleming and Dr. Tracie Newman. They will discuss their role in information dissemination, review the decision making process for Fargo Cass Public Health when making recommendations, along with the current status of masking in our community. Members from our Fargo Cass Public Health Physician Advisory Group will be present to speak on their area of expertise, including Dr. Carson (Infectious Disease), Dr. Nagpal (Infectious Disease), Dr. Mauriello (Pediatric Infectious Disease), Dr. Hanisch (Pediatric Psychiatry) and Dr. Syverson (Pediatric Rheumatology).

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MEMORANDUM

TO: CITY COMMISSION

DATE: FEBRUARY 16, 2022

FROM: NICOLE CRUTCHFIELD, PLANNING DIRECTOR NC

RE: SOLE SOURCE PROCUREMENT FOR DOWNTOWN INFOCUS CONTINUED WORK – INTERFACE STUDIO, INC. (SSP22027)

In 2016, Interface Studio was hired by the City through a public RFP process for a comprehensive plan for downtown. In 2018, the Downtown InFocus plan was adopted and is in use today. It's been nearly four years since adoption, and we are seeking services from Interface Studio in order to incorporate a status report and review against the plan's stated goals, findings from the pandemic and community updates.

Tasks within the scope of work include assessment of operational processes, data updates, confirm goals and targeted engagement, pandemic impact, and Downtown Community Partnership (DCP) alignment with Downtown InFocus. The attached scope of work provides more details.

Interface Studio was awarded the original contract through a public selection process, and staff would like to capture the investment of knowledge previously made. Attached please find the sole source procurement form and scope of work, which will be allocated with the Planning Services dollars approved within the 2022 budget. The work is estimated at $73,900.

The Finance Committee recommended approval of the contract with Interface Studio, Inc. at their January 31, 2022 meeting. (SSP22027)

Recommended Motion:
To approve sole source procurement for contract for services with Interface Studio, Inc. for the amount of $73,900.

EQUAL HOUSING OPPORTUNITY

Sole Source and Piggyback Procurement Form

Sole Source and Piggyback Justification for Procurement

The following information is offered for the sole source acquisition of goods or services described below. The purchase has been thoroughly researched and it has been determined that the vendor/brand is the only acceptable vendor/brand for the product or services that will fit the particular need.

Vendor Name:

Interface Studio, Inc.

Estimated Dollar Amount of Purchase:

$73,900

Is this procurement funded by a federal grant?

No

If yes, you must attach a document from the grant agency approving this procurement as a sole source.

The project/service is required to:

Review the Downtown InFocus Master Plan, now that it's been adopted for 3.5 years to incorporate a status report and review against the adopted plan based on findings from pandemic and community updates. Attached to the packet is the scope of work.

Description of features or capabilities unique to the vendor/brand being requested as related to project requirements:

Interface Studio was originally procured through a public RFP process. The competive processs resulted with a $500,000 procurement in 2016. The city and community were pleased with the Downtown InFocus plan and are still very much using the plan daily. Now that more downtown construction has been completed; such as, Block 9 along with other significant investments in tandem with economic and market impacts based on the last two years, staff felt it was important to consult with the Interface Studio team to document status and updates. For very low cost (comparative to starting with a new consultant team), the Downtown InFocus team makes the most sense for knowledge and efficiency.

Provide a brief description of how your investigation was conducted. (Internet, publications, consultations) List all sources identified and investigated to determine that no other source exists for similar products capable of meeting requirements (Must be exhaustive of all sources for the commodity being purchased. **)

Interface Studio was originally awarded the contract in 2016 through an RFP process. We would like to continue to work with this team to capture the investment previously made.

****If all sources are not investigated a competitive solicitation must be issued.**

Provide a side-by-side comparison of the features/service of all other vendors/brands considered. (List the features or capabilities required for your project and how each vendor investigated does or does not meet those requirements. A table format is recommended)

Interface Studio was originally awarded the contract in 2016 through an RFP process. Interface Studio has a deep understanding of Fargo's Downtown and we would like to continue to work with this team to capture the investment previously made.

If the piggyback procurement method is being used, please provide a copy of the piggyback contract.

N/A

Signature: _____
(Requestor)

Printed Name: Nicole Crutchfield

Department: Planning

Title: Planning Director

Date: 01/26/2022

I, hereby, certify that this justification for other than full and open competition is accurate and complete to the best of my knowledge and belief.

NBC
(Requestor initials)

_INTERFACE STUDIO LLC 340 N. 12th Street, #419, Philadelphia, PA 19107

AGREEMENT FOR PROFESSIONAL DESIGN SERVICES

This AGREEMENT entered into as of the 28th day of January 2022, between

Interface Studio LLC (a Pennsylvania limited liability company)
340 N. 12th Street, #419
Philadelphia, Pa 19107

and City of Fargo Planning Department
225 N. 4th Street,
Fargo ND 58102

hereinafter referred to as "Client"

for Downtown InFocus Update
hereinafter referred to as the "Project".

This letter serves as an agreement between the client and Interface Studio to update the Downtown Plan (Downtown InFocus) according to the services and estimated fee attached.

Interface Studio shall submit monthly invoices for the previous month's work. The monthly invoices shall be based on the amount of hours performed on the job by Interface Studio and their subconsultants.

This Agreement may be terminated immediately by either party upon breach by the other party of a material provision of this Agreement which breach remains uncured for more than ten days following receipt of notice thereof from the non-breaching party; or, for a breach which cannot be cured within ten days, for an additional period, reasonable in length, to allow the breaching party to effect a cure, provided that said party diligently pursues such cure, but in no event more than 30 days following receipt of initial notice from the non-breaching party.

Client and Interface Studio agree that other than the re-work obligation stated above, Interface Studio's total liability to client for any claims, losses, expenses or damages whatsoever, arising out of or in any way related to the Scope of Services performed by Interface Studio under this agreement from any cause or causes, is limited to direct damages to the extent caused by Interface Studio's negligent performance of such work or Interface Studio's willful misconduct in an amount not to exceed one hundred percent (100%) of the fees paid to Interface Studio for such Scope of Services (excluding fees attributable to third-party goods or services), and shall not include liability for any (i) special, indirect, incidental or consequential damages, (ii) damages arising out of loss of data, loss of use or loss of profits or (iii) costs associated with the correction of any construction of the Project.

This Agreement entered into as of the day and year first written above.

INTERFACE STUDIO LLC

By:

Title: Principal

CLIENT

By:

Title: _____

DOWNTOWN INFOCUS UPDATE

POTENTIAL TASK ITEM	TASK DETAILS	POTENTIAL COSTS: Interface				COSTS: Ninigret	POTENTIAL TIMEFRAME
PHASE 1							
		Principal: $150/hour	Sr. Associate: $130/hour	Staff: $95/hour	Total	Total	
TASK 1: ASSESSMENT OF PROGRESS TO DATE	Review Downtown InFocus and through conversations with City staff, develop a report card of progress to date. The report card will identify what was completed, in process and still outstanding. For outstanding items, the goal is to understand whether the strategies are still relevant or, what the major barriers are to implementation	4	24	8	$ 4,480	$ 500	**MONTHS 1 & 2**
TASK 2: DATA UPDATE	Review the recent changes to Downtown and the existing public spaces through data collection and select mapping. The idea is to develop a simple Downtown Dashboard that compares data and trends from the completion of Downtown InFocus with the conditions present today.	4	24	40	$ 7,520	$ 5,000	**MONTHS 1 & 2**
TASK 3: CONFIRM GOALS & TARGETED ENGAGEMENT	Through a series of interviews and targeted focus groups with key stakeholders, our team will discuss prior goals and affirm or suggest changes based on the feedback and discussion. We expect to complete 10 interviews and 4 focus groups for this process.	28	40		$ 9,400	$ 3,000	**MONTHS 3-4**
TASK 4: PANDEMIC IMPACT	Reviewing the updated data, our team will provide a short memo or slideshow on the challenges raised by the pandemic in terms of present day conditions and recovery. We will use data from other sources and cities to place Fargo's recovery in context.	8	8	24	$ 4,520	$ 3,000	**MONTHS 3-4**
TASK 5: DCP ALIGNMENT WITH DOWNTOWN INFOCUS	Our team will meet 3 times with DCP leadership to understand their organizational goals and how they align with Downtown InFocus. We will provide alternative scenarios for DCP action based upon the interest of leadership.	24	16		$ 5,680	$ 4,500	**MONTH 5**
TASK 6: FINAL DELIVERABLE	A summary slideshow and short document (approximately 20 pages) will be produced as an updated action plan reflecting the process and engagement.	16	40	40	$ 11,400	$ 1,000	**MONTH 5-6**
TASK 7: PROJECT MANAGEMENT	We expect 15 calls with City staff over the course of the work. Our expectation is that the work will occur over 6 months mostly to allow time to schedule meetings with key stakeholders.	30	30		$ 8,400	$ 1,000	**ONGOING**
TRAVEL / DIRECT EXPENSES	2 trips are expected. One at the outset and another during the process. Meetings that are not able to be scheduled during these trips will happen via video chat or telephone.				$ 4,500		
					SUBTOTALS:	$ 55,900	$ 18,000
					TOTAL:	$	73,900

THE CITY OF Fargo FAR MORE

Planning & Development
225 4th Street North
Fargo, ND 58102
Office: 701.241.1474 | Fax: 701.241.1526
Email: planning@FargoND.gov
www.FargoND.gov

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MEMORANDUM

TO: CITY COMMISSION

FROM: NICOLE CRUTCHFIELD, PLANNING DIRECTOR

DATE: FEBRUARY 16, 2022

SUBJECT: REQUEST FOR SOLE SOURCE PROCUREMENT WITH CZB, LLC IMPLEMENTATION OF CORE NEIGHBORHOODS MASTER PLAN SSP#22028

Background:
In January 2021, the City of Fargo Commission approved the Core Neighborhood Plan, which encompasses strategies and tools to implement a vision of strengthening the nine core neighborhoods surrounding downtown. Once adopted, Planning staff and the consultants spent 2021 developing more detailed operational plans for the top 5 implementation priorities of the plan (page 65 of the plan). Number 4 of these priorities is "Creating new housing reinvestment capacity to flexibly and proactively intervene with approximately 225 homes and 10 apartment buildings over a ten-year period". To quote the plan, "this activity is the single most departure from current practices....At least 18 months will be needed to create a new entity or repurpose an existing entity, secure capital commitments, build administrative capacity and design financial products and programs before money can start to flow into worthy projects."

Request:
Staff is seeking approval of a sole source procurement to contract with czb, LLC to assist the City of Fargo and provide support as we focus on the plan's recommendations for housing reinvestment activities. czb, LLC will divide the work in three distinct phases, with the goal to get the nonprofit development corporation ready to begin housing reinvestment activities in 2023.

This contract can be funded through the City of Fargo's Planning Services funds as allocated in the approved budget and is estimated at $114,000. For additional information, see the attached scope of work.

Phase 1: Determine if a new organization is the direction the city wants to proceed and identify if it would have complete support of the Fargo City Commission.

Phase 2: Confirm the details about the entity's mission and create a conceptual structure of the staffing, board make up, and preliminary five year budget.

Phase 3: Formally establishing and incorporating the new entity through the drafting of by-laws, corporate filing, and interim staffing while identifying one to five year goals and objectives.

The Finance Committee recommended approval of the contract with czb, LLC at their January 31, 2022 meeting. (#SSP22028)

Recommended Motion:
To approve sole source procurement for contract for services with czb, LLC for the amount of $114,000.

EQUAL HOUSING OPPORTUNITY

czb

Proposal to City of Fargo to Support Implementation of Core Neighborhoods Master Plan

In response to your request for a proposal to assist the City of Fargo with implementation of the Core Neighborhoods Master Plan (CNMP)—with a particular focus on the plan's recommendations for housing reinvestment activities spearheaded by a nonprofit development corporation—czb is pleased to offer the following scope of services, to be completed from March 1, 2022 to December 31, 2022, for a "not-to-exceed" figure of $114,000.

The scope is divided into three distinct phases of work to support the commencement of housing reinvestment activities in 2023.

Phase 1 – Confirmation of Direction

During this phase, answers will be sought to the following questions:

- Is a new organization (or the reactivation of a dormant organization) the course the City of Fargo wants to take?
- Does this course of action have the complete support of the Fargo City Commission?
- Is there enough probable interest in partnering with such an organization being expressed by key constituencies in the core neighborhoods and the wider community?

Finding answers to these questions will likely involve answering a series of other questions that might influence the level of understanding and support for a housing reinvestment entity, such as:

- What would be the explicit mission of the entity?
- What authorities would it have?
- What would its corporate status be?
    - If nonprofit, should it be c-3, 4, or 6?
- What re/development functions would it have?
- Would it have lending roles?
- Would it have equity roles?
- What would be the geography of activity?
- Who would "own" the organization?
- How would it be funded?
- How would it operate?

To support the work of this Phase, czb would undertake the following tasks in partnership with the City of Fargo's Department of Planning & Development:

Task 1.1: Appropriateness and Feasibility

- As regards the possible creation of a new or redevelopment of an existing organization that would be tasked with implementing Fargo's Core Neighborhoods Plan, determine if

a new or reconstructed entity is a) necessary, and (b) if so, on what terms (organizational, political, financial, legal, contextual) it would be sufficient to accomplish the objectives in the Core Neighborhoods Plan according to the timelines and frameworks in that plan.

Task 1.2: Strategy Review and Modification If/As Necessary

- As regards the possible creation of a new or redevelopment of an existing organization that would be tasked with implementing Fargo's Core Neighborhoods Plan, determine whether any substantive changes to the Core Neighborhoods Plan - outputs, scheduling, etc - are necessitated by market and other circumstances that may have changed since the plan's adoption, and adjust the draft scope of the new organization accordingly.

Task 1.3: Environment/Context Work

- As regards the possible creation of a new or redevelopment of an existing organization that would be tasked with implementing Fargo's Core Neighborhoods Plan, determine the extent to which the potential new entity has support from the City Commission and the nature of any lack of support or conditions for support, and prepare all learnings for incorporation into the new organization's draft mission and draft by-laws.

Phase 2 – Complete Pre-Establishment Activities

As direction is confirmed and details about the entity's mission and roles become well-defined, work should begin on the following items in advance of formal work to set up the entity:

- Preliminary board
  - Structure
  - Recruitment
- Staffing
  - Structure
  - Recruitment
- Preliminary Five-Year Budget
  - Uses
  - Sources

To support this work, czb proposes to undertake the following tasks in partnership with the City of Fargo's Department of Planning & Development:

Task 2.1: Board Development

- Determine the optimal size and composition of the provisional and permanent board of directors for the organization.
- Work with city staff and members of the City Commission to schedule meetings with potential provisional and permanent board members; hold/facilitate meetings to obtain input on possible board composition and on organizational mission and structure.
- Work with representatives of the development, real estate, construction, nonprofit/advocacy, and other fields to obtain input on possible organizational mission and structure.

Task 2.2: Organizational Development

- Prepare a draft organizational table articulating staffing levels, cost structures for operations/administration, etc.
- Prepare draft policies and procedures manual for new organization in two respects:
  - Tasks and standard operating procedures for 90 days prior to incorporation
  - Tasks and standard operating procedures for first 90 days

Task 2.3: Budget

- Develop a preliminary 30-day, 90-day, one-year, three-year, and five-year operating and capital budget for the organization.

Phase 3 – Formally Establish and Incorporate the Entity

During Phase 3, actions should be taken to formalize the direction confirmed and decisions made through Phases 1 and 2. These include:

- Standing up the new organization
  - Draft Articles and By-Laws
- Arrangement of organizational details
  - Confirmation of provisional board of directors
  - Selection of interim executive director
  - Formalize a five-year funding commitment
  - Take care of corporate filings (IRS and ND State Corporation Commission)
  - Set up bank accounts
  - Choose office space
- Arrangement of operating details
  - Provisional slate of 2023 projects
  - Draft standard operating procedures

To support this work, czb proposes to undertake the following tasks in partnership with the City of Fargo's Department of Planning & Development:

Task 3.1: Corporate Filing

- Prepare corporate filing with appropriate North Dakota legal counsel.

Task 3.2: Interim Organization

- Obtain chartering documents from state corporation commission and IRS.
- Determine funding levels from partner organizations.
- Development partnership agreements for first-year funding and five-year funding commitments.
- Obtain agreements and fund organization, inclusive of operations and capital.
- Assist with establishing new accounts and selection of office space.

Task 3.3: Years 1-5 Goals and Objectives

- Prepare summary five-year plan.
- Prepare detailed 18-month plan of activities with costs.

Task 3.4: Interim Staffing

- Assist with recruiting and securing interim executive director and other interim staff.
- Draft job descriptions, salary structure, benefits structure, etc.

- Work closely with interim director and members of the provisional/interim BOD to prepare staff and members to launch on January 1, 2023 as a fully operations-ready nonprofit corporation.

Timing and Budget
czb proposes to deliver these services for a duration of approximately 10 months—from March 1, 2022 to December 31, 2022—with monthly invoice amounts based on % completion of tasks. An estimated breakdown of hours and budget allocated to each deliverable is as follows:

	Hours					Cost
	Charles Buki	Eric Ameigh	Thomas Eddington	Peter Lombardi	Total Hours	
Task 1	40	10	40	40	130	$24,750
Task 2	80	20	60	80	240	$46,000
Task 3	60	10	80	80	230	$43,250
Tasks Total	180	40	180	200	600	**$114,000**
Hourly Rate	$225	$175	$175	$175		

Task	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1.1		X								
1.2		X								
1.3			X							
2.1						X				
2.2						X				
2.3							X			
3.1										X
3.2										X
3.3										X
3.4										X

X=projected month of completion

czb Travel to Fargo
czb proposes a travel allowance of $1,000 per person trip, with a maximum of five (5) person trips to Fargo if in-person attendance is desired. In-person attendance at meetings will be agreed upon by the Planning Director and czb President, and authorized in writing by the Planning Director. The maximum travel budget is $5,000 and the trip allowance will be invoiced for the months in which the trips take place.

ACCEPTANCE

By signing below, the City of Fargo approves the terms described herein.
Name (Printed): _____
Signature: _____
Title: _____
Date: _____

CONSULTANT

czbLLC, a Maine limited liability corporation

By:_____

Charles Buki, President

Sole Source and Piggyback Procurement Form

Sole Source and Piggyback Justification for Procurement

The following information is offered for the sole source acquisition of goods or services described below. The purchase has been thoroughly researched and it has been determined that the vendor/brand is the only acceptable vendor/brand for the product or services that will fit the particular need.

Vendor Name:

czb, llc

Estimated Dollar Amount of Purchase:

$114,000

Is this procurement funded by a federal grant?

No

If yes, you must attach a document from the grant agency approving this procurement as a sole source.

The project/service is required to:

Provide support with implementation fo the Core Neighborhoods Master Plan (CNMP) which includes research and creation of a nonprofit development corporation focusing on housing reinvestment activities.

Description of features or capabilities unique to the vendor/brand being requested as related to project requirements:

At the end of 2019, czb was awarded the contract to develop the Core Neighborhoods Master Plan after being unanimously selected as the top proposing firm out of a total of 13 project proposals received through a competitive RFP process. Throughout 2020, czb worked with City staff do develop the Core Neighborhoods Master Plan. The Core Neighborhoods Master Plan was adopted January 2021 and identified vision, values, and palnning principles for the core neighborhoods. The work performed on the Core Neighborhoods Master Plan led to the creation of a core neighborhoods toolkit. The toolkit within the plan determined the need to create new housing reinvestment capacity through the posibility of creating an entity to achieve this goal.

Due to the extensive work completed so far, and their solid understanding of the unique growth challenges that the City of Fargo will likely face in the near future, we feel that czb is uniquely positioned to elaborate upon their previous work by expanding their analysis from the core neighborhoods to the City as a whole.

Provide a brief description of how your investigation was conducted. (Internet, publications, consultations) List all sources identified and investigated to determine that no other source exists for similar products capable of meeting requirements (Must be exhaustive of all sources for the commodity being purchased. **)

The original contract for the Fargo Core Neighborhoods Master Plan was awarded via competitive RFP process, which was advertised in multiple local and national publications, including the American Planning Association RFP/RFQ website. In many ways, the requested procurement is essentially an addition of scope for this original competative contract.

****If all sources are not investigated a competitive solicitation must be issued.**

Provide a side-by-side comparison of the features/service of all other vendors/brands considered. (List the features or capabilities required for your project and how each vendor investigated does or does not meet those requirements. A table format is recommended)

There is no other entity that has the national neighborhood planning expertise and the local knowledge and relationships necessary to do this work. A thorough understanding of neighborhood dynamics and their application to Fargo's local context is a requirement for success, which cannot be replicated by any other firm without a substantial amount of on-boarding and relationship building on top of the proposed scope of work.

If the piggyback procurement method is being used, please provide a copy of the piggyback contract.

N/A

Signature: _____
(Requestor)

Printed Name: Nicole Crutchfield

Department: Planning & Development

Title: Director

Date: 1/26/22

I, hereby, certify that this justification for other than full and open competition is accurate and complete to the best of my knowledge and belief.

_____ **(Requestor initials)**

THE CITY OF Fargo FAR MORE

City Administration
225 4th Street North
Fargo, ND 58102

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MEMORANDUM

TO: **Fargo City Commission**

FROM: **Jim Gilmour, Director of Strategic Planning and Research**

DATE: **February 2, 2022**

SUBJECT: **Sale of 1 – 2nd Street South**

This is the recommendation to sell City of Fargo property at 1 – 2nd Street South for redevelopment.

Background

The Fargo City Commission directed preparation of a Riverfront Renewal Plan in October 2020. The Riverfront Renewal Plan was completed and adopted by the City Commission in April 2021. This plan included actions to sell several city-owned properties for redevelopment.

Request for proposals and selection criteria for the three properties were approved by the City Commission in September and October 2021 and proposals were due in November. Three proposals were submitted for the 1 -2nd Street South property.

Review

Proposals were reviewed by the Economic Development Incentives Committee and the Renaissance Zone Authority. Of the 8 members of these Committees voting at a January 25th meeting, 5 of the members voted to recommend selection of the proposal from EPIC Companies.

EPIC Proposal

The EPIC proposal is a mixed-use building that will be part of a complex including two previously approved new buildings. The 7-story building will have 30 condominiums, 37 apartments, 15,000 square feet of commercial space and interior parking. The building will cost $28 million. The offer is for $1,188,000 with construction to begin in the fall of 2022 with planned completion in late 2023. The developer is requesting approval of 5-year Renaissance Zone incentives. A copy of the proposal is attached.

Recommended Motion:

Accept the offer from EPIC Companies for 1 – 2nd Street South and direct City staff to plat the property prior to the sale and draft a Development Agreement consistent with City plans and the offer from the developer.

Proposal Submission:
November 17, 2021

Prepared for:
Jim Gilmour
Office of the City Auditor
225 4th Street North
Fargo, ND 58102

The City of Fargo
Request for Development Proposals

Disposition of 1 2nd Street South

EPIC COMPANIES
Investment • Development • Management

745 31st Ave. E Ste 105, West Fargo, ND 58078
701.866.1006
EPICCompaniesND.com
Todd.Berning@EPICCompaniesND.com

211117

LETTER OF INTEREST

THANK YOU FOR CONSIDERING US!

Dear Mr. Jim Gilmour,

Thank you for the opportunity to present you with this proposal. As you will see throughout our proposal, EPIC Companies has experience with numerous developments in the region. We would be honored to work on the 1 2nd Street South Fargo, ND lot, to develop it into an asset the community can be proud of.

Fargo has worked hard to successfully ensure the quality of life for its citizens with great schools, good health care, excellent public service works, and access to natural beauty along the Red River.

Our vision is to build a mixed-use development with commercial and residential spaces that will focus on catering to multiple audiences. EPIC Companies is a regional leader with completed mixed-use projects in operation (Bismarck, Detroit Lakes (MN), Fargo, Jamestown, Minot, Moorhead (MN), and West Fargo) plus additional projects in construction/design stages throughout the region (Bismarck, Fargo, Grand Forks, Minot, and West Fargo).

We understand the commitment to this project, to perform the services expeditiously and in a timely manner. As the developer, we understand the scope of work and will do our due diligence to complete the project. This parcel of land is currently underutilized and our goal is to create a gateway, from Moorhead to Fargo, a positive welcome to this great city that residents and travelers alike can be proud of.

EPIC Companies has over 25 mixed-use buildings in their portfolio. This includes 1000+ residential units and 350,000+ square feet of commercial space. Of the 1000+ residential units, around 153 of them are affordable housing, and we are currently developing over 50+ condos, which provide vital housing to the areas they serve. We are community driven and focused. Our experience spans from mixed-use developments, multi-family housing, affordable housing, and numerous financing options.

Each group involved has the ability to deliver quality performance and results in key areas such as: Planning, Legal, Public-Private Partnerships, TIF/Tax Abatement, Design, Finance, Gifting and Tax Strategies, Construction, Plaza Design, Leasing, Maintenance and Management; each step is required for an accomplished project of this size and scope.

Our company's mission, "Enhancing communities through innovative development", is our intention with this project. We want to create a positive impact on this neighborhood by complimenting the current developments of the community, as well as creating a building with distinct character that separates it from the masses. Our local connections as residents of North Dakota show we are very well acclimated not only to the development location, but the entire region. We have thoroughly analyzed all aspects of development, design, and construction for this project. Our goal is to provide a foundation for feeling safe with an opportunity to succeed in a community.

Our commitment to providing a better quality of life through mixed-use buildings shines through in the following portfolio. We appreciate your time and consideration, and look forward to hearing from you regarding our proposal.

Todd Berning
President | 745 31st Ave. E Ste 105, West Fargo, ND 58078

ENHANCING COMMUNITIES THROUGH INNOVATIVE DEVELOPMENT.

01

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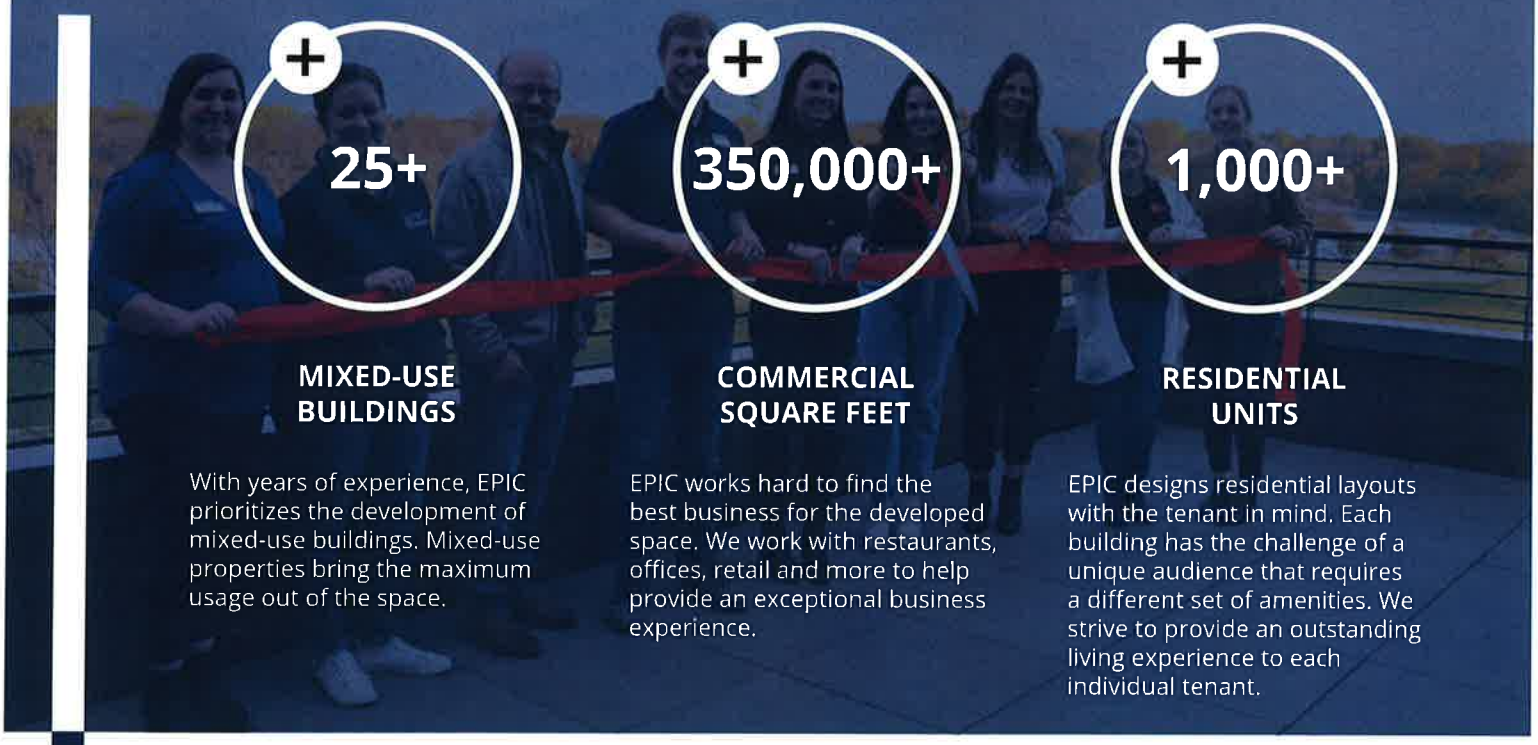
02 ABOUT EPIC COMPANIES

A North Dakota Company



25+

MIXED-USE BUILDINGS

With years of experience, EPIC prioritizes the development of mixed-use buildings. Mixed-use properties bring the maximum usage out of the space.

350,000+

COMMERCIAL SQUARE FEET

EPIC works hard to find the best business for the developed space. We work with restaurants, offices, retail and more to help provide an exceptional business experience.

1,000+

RESIDENTIAL UNITS

EPIC designs residential layouts with the tenant in mind. Each building has the challenge of a unique audience that requires a different set of amenities. We strive to provide an outstanding living experience to each individual tenant.

OUR VALUES

Evolve and Adapt

At EPIC Companies, we empower our employees to make decisions, and constantly strive to improve with each project we develop.

Build Relationships

We believe that connecting with our tenants, investors, and employees helps drive success.

Open Communication

EPIC encourages directness so our employees and their ideas can thrive.

Change Your Thoughts, Change Your World

By simply changing your thoughts, one can change the world around you.

Be Humble

We are confident, but are aware of our weaknesses and continue to strive for improvement.

02 OUR MISSION

ENHANCING COMMUNITIES THROUGH INNOVATIVE DEVELOPMENT.

EPIC COMPANIES AND OWNERS COMBINED PROJECT EXPERIENCE

* Prior Firm Experience

ACQUISITION

EPIC Place - Grand Forks, ND (Newly Remodeled)
Four Points by Sheraton - Fargo, ND
The Mill - Grand Forks, ND (Newly Remodeled)

IN DEVELOPMENT

Allie Commons - West Fargo, ND
Bolig Square - Moorhead, MN
Liberty Town Center - Fargo, ND
JP Place - Perham, MN
The Tracks - Minot, ND

UNDER CONSTRUCTION

Area 57 Phase II - Bismarck, ND
Boulevard 3 by EPIC - West Fargo, ND
ENVY at The Lights – West Fargo, ND
Park South II - Minot, ND
Makt by EPIC - Fargo, ND
TAB42 - Fargo, ND
The Arch - Fargo, ND
The Beacon – Grand Forks, ND

DEVELOPED PROJECTS

Arbor Courts - Fargo, ND
Area 57 Phase I - Bismarck, ND
Beaver Ridge - Minot, ND
Betty Engelstad Sioux Center - Grand Forks, ND *
Block E - Moorhead, MN
Blu on Broadway - Minot, ND
Boulevard Square I & II - West Fargo, ND
Broadway Plaza - Minot, ND *
County Jail - Grand Forks & Rugby, ND *
Gateway by EPIC - Fargo, ND
EPIC at The Lights - West Fargo, ND
ECHO at The Lights - West Fargo, ND
Frito Lay - Minot, ND *
Highlander Office Park - Minot, ND
Lignite Apartments - Lignite, ND
Meadowlark Town Homes - New Rockford, ND
McKinley Plaza - Detroit Lakes, MN
Minot Country Club - Minot, ND
NDSF Grandstand - Minot, ND
Park South Phase I - Minot, ND
Pioneer Place - West Fargo, ND
Northern Mall Partners - Grand Forks, ND
Ralph Engelstad Arena - Grand Forks, ND *
Ralph Engelstad Arena - Thief River Falls, MN *
Scheels Arena - Fargo, ND *
Sheyenne Plaza - West Fargo, ND
The Firm - West Fargo, ND
UJ Place - Jamestown, ND
Urban Plains Office & Retail - Fargo, ND *
Vanné - Moorhead, MN

DEVELOPED PLAZAS

POW/MIA Plaza - West Fargo, ND
Essentia Health Plaza at The Lights - West Fargo, ND

EPIC Companies

Serving 9 Communities Throughout ND & MN.

03 EXPERIENCE & QUALIFICATIONS

WE UNDERSTAND MIXED-USE DEVELOPMENT

WHY EPIC

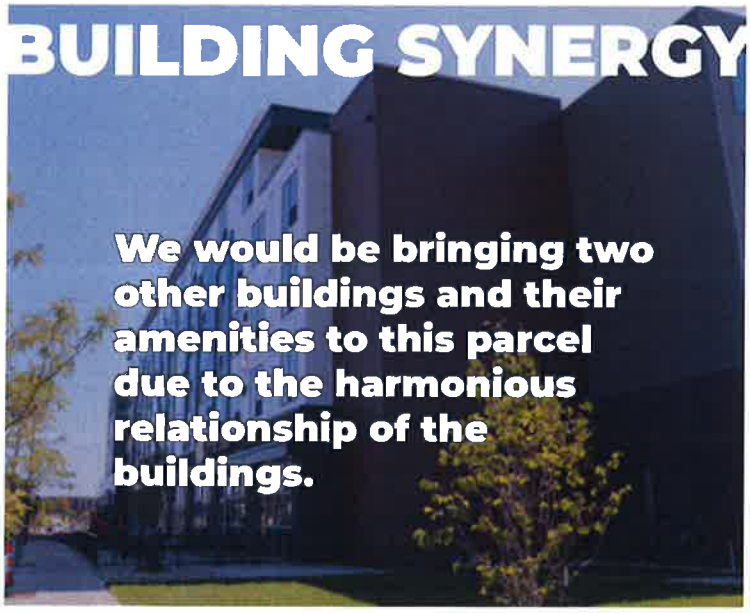
EPIC Companies will make certain that our services will meet and exceed your needs. We are committed to providing the leadership, qualified staff members, and necessary resources to conclude the project.

RELATIONSHIP TO BUILD UPON

The project team has a solid relationship that has been created by working together on multiple developments. Our organizations are on a first name basis and we have a proven track record for working together to meet budget and schedule goals.

LOCAL STAFF AND RESOURCES

Our leadership and professional staff combined live in Fargo, West Fargo and Moorhead. We have thorough understanding of the local working conditions. Time and time again, our subcontractor relationships have saved valuable time and money. We know how to build the right team for your project.



MIXED-USE HOUSING EXPERTISE

EPIC Companies has developed a specialized team of designers, developers, and construction professionals with a wide range of experience in completing mixed-use projects. The team is experienced in both new construction and renovation of historic spaces. Our goal is to maximize our unit square footage and provide efficient units to the public. EPIC is experienced and well-versed in completing mixed-use developments for a variety of audiences.

03 AN EPIC UNDERSTANDING OF DEVELOPMENT PROCESS

EPIC Companies has the personnel, experience, partners, and overall expertise to provide the City of Fargo with a quality mixed-use project. Over the years, we have refined our processes and gained significant resources that are critical to making an effective development. Our process is based upon three key words: **INVESTMENT**, **DEVELOPMENT**, and **MANAGEMENT**.

The first goal in the development process is raising capital. One of our biggest assets as a development company is our financial capability. EPIC is a privately held company that partners with other private equity consultants to raise funding for each individual project. We have experience working with multiple accounting and CPA firms, private equity partners, and other groups who help us meet our funding goals.

Open communication is important in the development process, not only with the client, but with the investors. EPIC keeps open communication with investors through our online investor portal, annual investor meetings, and investor socials. Investors have access to their private portfolio and can access rent rolls, income statements, construction reports, balance sheets and tax returns at any time.

> **"WHILE MUCH OF THE CITY'S FOCUS HAS BEEN ON BOOMING RESIDENTIAL AND COMMERCIAL DEVELOPMENT A RELATIONSHIP WITH EPIC HAS ALLOWED US TO FOCUS ON AMENITIES, COMMUNITY DEVELOPMENT AND THE INTANGIBLE ELEMENTS THAT MAKES A PLACE SPECIAL.**
>
> **- TINA FISK, CITY OF WEST FARGO ADMINISTRATOR**

Our ability to finance projects is indicated in our letters of support as well as shown through our mixed-use experience. EPIC Capital, the investment arm of EPIC Companies, led by Bill Leier, utilizes investment vehicles such as traditional equity investments, 1031 exchanges, fixed-rate subordinate debt notes, and self-directed IRA's.

Once funds are acquired, the next phase is the development process. EPIC Companies has partnered with local firms that have years of experience. These firms are Construction by EPIC, Gehrtz Construction Services, Confluence, MBN Engineering, and Heyer Engineering.

EPIC is projecting a development that includes residential and commercial space. EPIC's in-house architect, Ben Zeltinger, and heads of development, Amy Hass, Brian Kounovsky, and Blake Nybakken will guarantee coordination between all parties involved. We work with the demands of the design team to make sure the design phase aligns with the financial model and appeals to all parties involved.

03

> "THEIR COMMUNICATION AND FLEXIBILITY HAS BEEN TREMENDOUS WHICH HAS MADE THE PROJECT MOVE ALONG VERY SMOOTHLY AND EFFICIENTLY.
>
> - UNIVERSITY OF JAMESTOWN

EPIC Companies works carefully with the planning and zoning officials, engineering departments, and the city staff to follow all local and federal guidelines in the development phase. Our team conducts regularly scheduled meetings to open lines of consistent communication and to align the firm's focus to be on task and cognizant of moving parts to help not overlook potential setbacks. We provide additional layers of oversight for the good of the project. EPIC has successfully accomplished multiple PUD's and P3 agreements in different municipalities and are very comfortable with the process. We also bring in experts, such as John Shockley and Katie Bertsch of Ohnstad Twichell, to guide us through the process.

All EPIC Companies' previous mixed-use developments have been delivered on time and on budget. We project a 18 month timeline for a project of this scope and size. EPIC Companies' ability to lease residential units is unmatched, with occupancy rates nearing 100%. This is highlighted even further in our project portfolio. EPIC takes pride in being able to adapt to different markets and circumstances and is willing to pivot direction for the good of the project. Our main goal is the overall performance of the project and best interest of our investors.

We work hard, ensuring that our vacancy rate is low to non-existent. A low vacancy rate is a product of teamwork. Behind the scenes, our maintenance, marketing, and management teams work together to achieve the goal of providing exceptional work and service in their individual departments. EPIC has created an intelligent and creative community that is more than qualified to successfully produce this mixed-use development.

> "FARGO IS A CITY WITH A LOT GOING FOR IT. FARGO WEATHERED THE CURRENT ECONOMIC RECESSION WITH REMARKABLE RESILIENCE AND STILL MAINTAINS A LOW UNEMPLOYMENT RATE ALONG WITH A DIVERSE AND PRODUCTIVE ECONOMY. FARGO'S EDUCATION SYSTEM, FROM KINDERGARTEN THROUGH COLLEGE, IS AMONG THE NATION'S FINEST. FARGO HAS A WELCOMING COMMUNITY AND IS GROWING IN POPULATION AND NATIONAL INFLUENCE.
>
> -FARGO GO2030 COMPREHENSIVE PLAN

04 PROJECT SCHEMATICS

1 2ND STREET SOUTH, FARGO, ND 58102

DESCRIPTION OF PROPERTY

PRELIMINARY SCHEMATIC PLANS

- 7 Stories
- 37 Apartments
- 30 Condos
- 75,000 SF

BUILDING SIZE

This building will be a total of 90,000 SF, 7 stories tall, contain 2nd floor parking, and a basement.

The first floor will hold 15,000 SF of commercial space. Floors 3-7 will house 37 apartment units and 30 condos at a total of 75,000 SF. The 2nd floor will include 35 parking spaces.

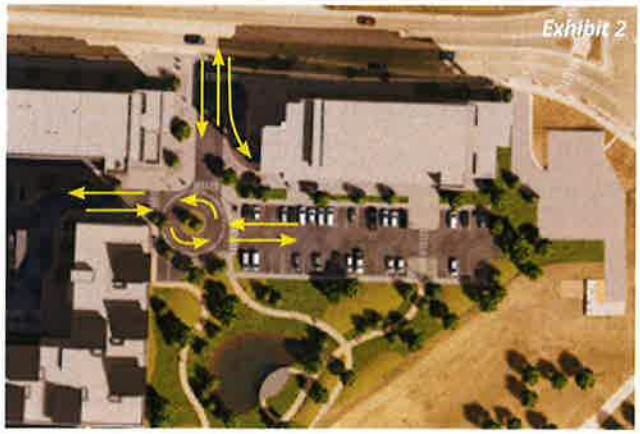
MATERIALS & DESIGN *See Exhibit 1*

Commercial siding similar to the Gateway by EPIC building.

- Metal panels of masonry
- Store front glass
- Cement board siding

CIRCULATION PATTERNS *See Exhibit 2*

Maintaining a flow of traffic on Main Street is important in this property design. The proposed design mitigates incoming traffic through the existing curb out located in front of the Gateway by EPIC building. Both incoming and outcoming traffic will be served through this driveway.



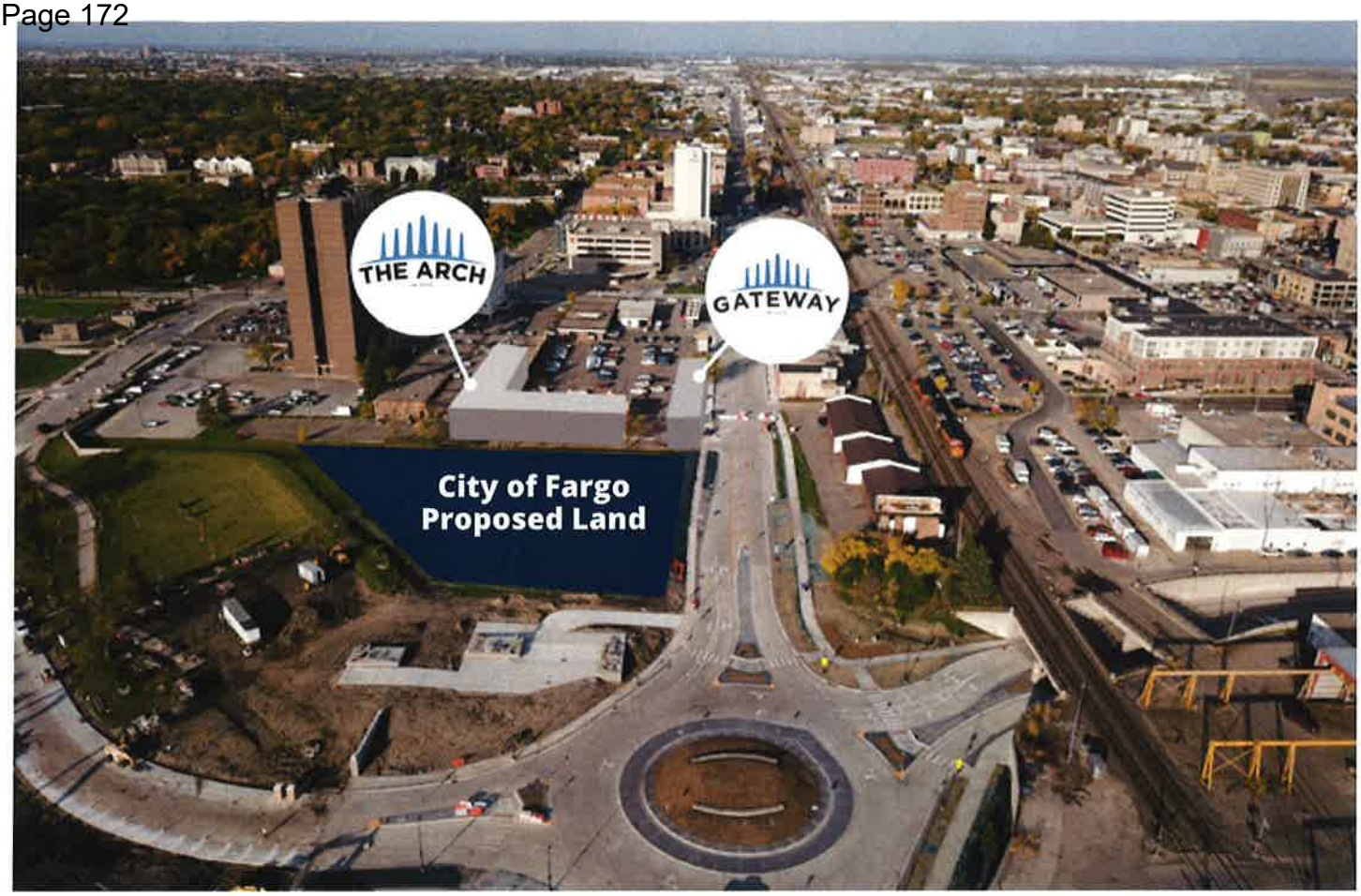
LOADING/SERVICE *See Exhibit 2*

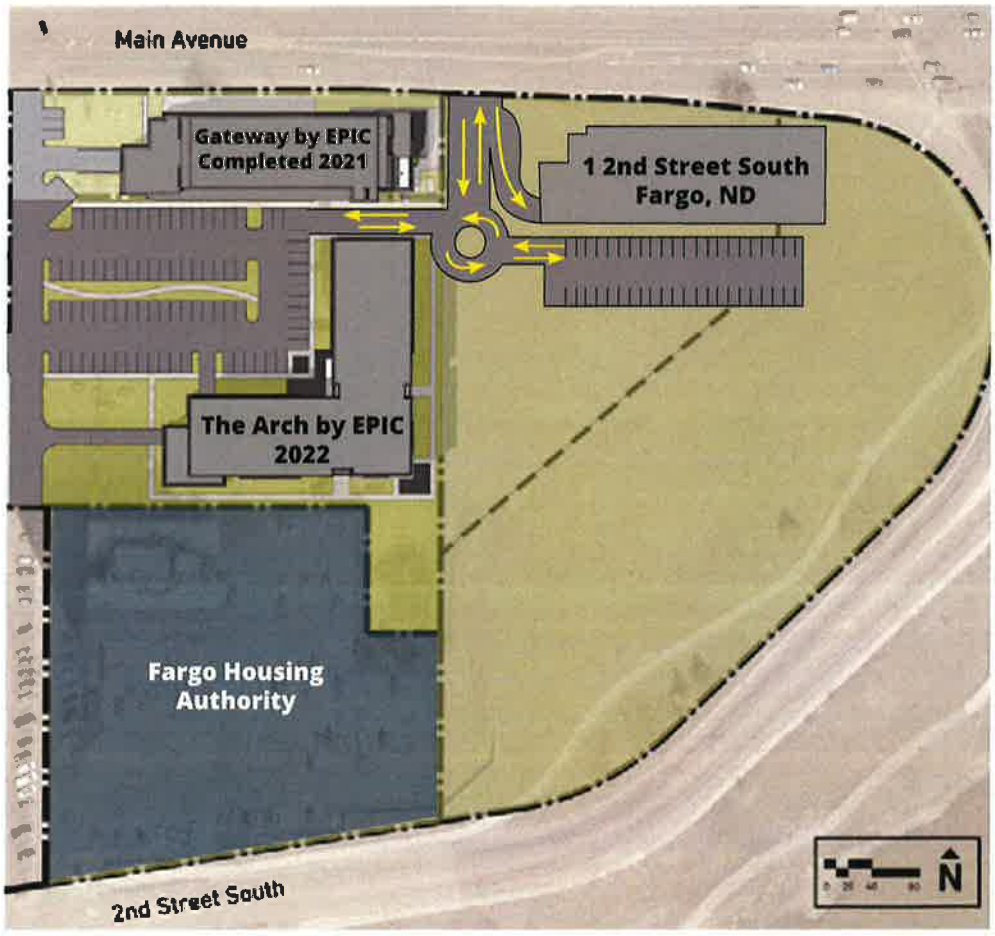
This development will be connected by round-about to Gateway by EPIC and offer a shared parking lot for fluid access and off street parking.

TOTAL PROJECT COST:

$23,000,000

*Approximate numbers on projects building size.





PROPOSED BUILDING SPECS

Underground
- 35 Parking Spaces

1st Floor
- Shared Parking Spaces
- 15,600 Commercial SF

2nd Floor
- 35 Parking Spaces

3rd Floor
- 18 Apartments

4th Floor
- 19 Apartments

5th Floor
- 10 Condos

6th Floor
- 10 Condos

7th Floor
- 10 Condos

05 PROPOSAL

CONSIDERATION FOR CURRENT DEVELOPMENT

INTEGRATION OF WHOLE DEVELOPMENT

Shared Services • Shared Parking • Outdoor Space • Commercial Businesses
Owners and Renters of Units

05 TIMELINE

The construction for this project will be done by **Gehrtz Construction Services**.This project will begin construction approximately summer of 2022 and be completed fall of 2023.

DOCUMENTS COMPLETION

Winter 2022
All documents on land ownership will be completed and filed.

LAND TURNED OVER

June 2022
Land purchased by EPIC Companies.

CONSTRUCTION BEGINS

Summer 2022
Construction begins work on 1 2nd St. S, Fargo. *For construction timeline refer to page 27.*

COMPLETION

End of Year 2023
Construction complete and ready to be leased and managed by EPIC Management.

Walkable, Mixed Use Centers

Walkable mixed use centers will be catalysts for well designed, high density development that increases walk-ability, access to amenities, and provides other sustainable benefits of density.
- Fargo Go2030

Celebrate the River

Flooding from the river has been a threat in years past, but there is potential to create great public spaces next to the river. These locations would give access to the river and can potentially be combined with flood protection and development projects.
- Fargo Go2030

06

IDENTIFICATION OF ENTITIES

EPIC COMPANIES & TEAM

DEVELOPER

EPIC COMPANIES
Investment • Development • Management

PROJECT MANAGER

CBE CONSTRUCTION BY EPIC

CONSTRUCTION

gehrtz CONSTRUCTION SERVICES

ARCHITECT

If awarded, EPIC Companies will do an RFP for Architecture services.

LANDSCAPE ARCHITECT

CONFLUENCE

ENGINEERING

MBN ENGINEERING

HEYER ENGINEERING
STRUCTURAL CONSULTANT

06

EPIC COMPANIES

745 31ST AVE E, SUITE 105
WEST FARGO, NORTH DAKOTA
701.866.1006

EPIC COMPANIES
Investment • Development • Management

At EPIC Companies, we believe our people are what truly make the difference. We believe every job is important, no matter the scope. We are innovators who work relentlessly to bring ideas to life.

Todd Berning
President

Brian Kounovsky
Vice President

Amy Hass
CEO

Blake Nybakken
COO

Vicki Campbell
CFO

Ben Zeltinger
Director of Design

CBE CONSTRUCTION BY EPIC

EPIC Companies continues to have an aspirational vision for the future, the addition of CBE is a testament to that. We built this team to bring in highly experienced professionals that are hard-working, high-energy, and self-motivated. By doing this, the team brings over 50 years of combined construction experience.

Andy Quittschreiber
Vice President of Construction

Nick Giobres
Construction Manager

EPIC COMPANIES

06

GEHRTZ CONSTRUCTION

510 4TH AVE N
FARGO, NORTH DAKOTA
701.297.0704

With offices in Fargo and Minot, North Dakota, **Gehrtz Construction Services** works with a variety of personality types, trades, and work groups. We're known for our people who are honest, hardworking, professional, and energetic. Through our dedication and integrity, our team members work together to build collaborative relationships with owners, architects, engineers, and subcontractors.

Our company takes a collective approach to all construction and construction management projects, working closely with owners and designers. Well before ground is broken, we provide construction estimating, scheduling information, and valued engineering services that allow you to make informed decisions so your construction project can be completed efficiently at the highest possible quality.

QUALITY & COMMITMENT

Our dedication to quality, customer satisfaction, and integrity is illustrated in our management philosophy and expertise that we bring to every project. With many years of combined experience, our construction management team and field construction managers have become experienced problem solvers in providing full-service construction project management and coordination.

These Points Allow Us to Create a Seamless Process For All Projects:

- All principle players are involved from before the ground is broken until owner occupancy.
- Regular scheduled meetings throughout the project keep all lines of communication open.
- Safety regulations are discussed and a master safety program is prepared to ensure confidence in a safe workplace.

Steve Gehrtz
Owner, Construction Manager

06

CONFLUENCE

10 BROADWAY NORTH, SUITE 302
FARGO, NORTH DAKOTA
701.235.3990

CONFLUENCE

WHO WE ARE

Confluence is a professional consulting firm comprised of landscape architects, urban designers and planners. Our staff of 71 includes 39 licensed landscape architects and AICP certified planners – and our firm is comprised of energetic, creative, and passionate people who are involved in making our communities better places to live. We assist our clients on a wide range of public, educational, institutional and private sector projects. Our landscape architects are licensed to practice in Colorado, Kansas, Iowa, Idaho, Illinois, Michigan, Missouri, Minnesota, Montana, Nebraska, North Dakota, South Dakota, Wisconsin, Wyoming, Texas and Utah – and this list continues to grow to meet our client's needs.

WHAT WE DO

Simply stated - we create places full of life. The diversity of our work and expertise has become a hallmark of our firm, and it's a big reason why our clients engage us again and again to help establish their next creative vision for the future. We offer a wide array of design and planning capabilities, handling everything from stakeholder and community engagement activities, to crafting urban design and community planning solutions, to representing our clients during construction implementation. With over twenty years of award-winning experience and hundreds of completed projects, Confluence has shaped the practice of landscape architecture, planning and urban design across the Midwest, and we love what we do. What can we do for you?

HOW WE WORK

Our creative process is focused on collaboration and insightful interaction with our clients, consultants and the community in which we work. We begin by gaining an insightful and objective understanding of each project, including how it fits into the surrounding context. This includes analyzing existing conditions, identifying challenges and defining the specific issues that need to be resolved. From vision to completion, our team excels in collaborating to shape and achieve your "what's next" – while also planning ahead on your long-term strategy. The diversity of our practice and professional experience provides a solid framework upon which to build successful strategies for achieving our client's goals.

Brian Reinarts, ASLA
Associate Principal

EPIC COMPANIES

06

MBN ENGINEERING

503 7TH STREET NORTH, SUITE 200
FARGO, NORTH DAKOTA
701.478.6336

MBN Engineering, Inc., an S Corporation, was established in 2007 to provide engineering services to the upper Midwest. The firm provides civil, electrical, mechanical, and transmission engineering services.

With over 100 years of combined experience, our principles lead a team of innovative design professionals. We are committed to providing engineering services that are tailored to each of our clients' needs. Our primary goal is to ensure a successful outcome on every project that we are involved with.

CIVIL NARRATIVE

Overview

The project will consist of multiple mixed-use type buildings tied together utilizing urban landscaping that is prevalent in the surrounding downtown corridor. Pedestrian connectivity will have a heavy influence on site design as well as maximizing parking opportunities on-site due to the lack of surrounding on street parking. All pedestrian paths will follow ADA guidelines.

Elevations

Finish floor elevations will be set in accordance with the City of Fargo requirements for both the FEMA Floodplain and the 41-foot inundation elevation, whichever is greater. The adjacent lot to the west has a fairly significant elevation drop towards the south and west. This may trigger the need for small, stepped, retaining walls so as to not negatively impact the neighboring property.

Storm Sewer

MBN Engineering will work with City of Fargo officials to determine the most adequate methodology to provide storm water retention & treatment. MBN has been involved with a majority of the larger projects in the downtown area and is familiar with stormwater requirements within DMU zoning. These projects typically evaluated the pre-development conditions versus post-development conditions to determine the allowable release rates to be discharged to the municipal sewer. Water quality requirements will be met with a hydrodynamic separator or similar.

Mike Berger, P.E., LEED AP BD+C
Electrical Project Manager

Tony Sager, PE
Civil Project Engineer

06

HEYER ENGINEERING

4180 24TH AVE S.
FARGO NORTH DAKOTA
701.280.0949

Heyer Engineering, Inc., a full-service structural engineering firm established in 1983, has completed over 15,000 projects in more than 40 states and internationally with total project costs of $5 billion plus.

With a culture of mutual respect, trust, excellence in service, creative thinking, collaboration, and dedication to quality, individually and as a group, we work diligently on behalf of our clients and the communities we serve.

To make our client's dream a reality, our firm provides unique expertise in structural design, engineering, and 3D modeling.

We are experts in steel, wood, concrete, prestressed and precast concrete, masonry, light gauge steel framing, and aluminum construction.

MIXED-USE PROJECT LIST

- Boulevard 3 by EPIC (2022) - West Fargo, ND
- The Arch by EPIC (2022) - Fargo, ND
- ENVY at The Lights (2022) - West Fargo, ND
- Gateway by EPIC (2021) - Fargo, ND
- Mercantile (2020) - Fargo, ND
- ECHO at The Lights (2020) - West Fargo, ND
- UJ Place (2020) - Jamestown, ND
- Pioneer Place (2018) - West Fargo, ND
- Downtown Shakopee Apartments (2019) - Shakopee, MN
- EPIC at The Lights (2018) - West Fargo, ND
- Area 57 (2018) - Bismarck, ND
- Pioneer Place (Phase I) (2017) - West Fargo, ND
- Ain Dah Yung Center (2017) - St. Paul, MN
- Alexandre Marie Apartments (2013) - Fargo, ND
- WSC Housing (2012) - Williston, ND
- Civic Auditorium Redevelopment (2010) - Grand Forks, ND
- Cityscapes Plaza (2008) - Fargo, ND
- Jackson Place Development (2005) - Elk River, MN
- Bluff Block (2005) - Elk River, MN
- University Place (2005) - University of North Dakota Campus
- Woodhaven Plaza (2004) - Fargo, ND
- Stone West Village (2004) - Moorhead, MN & Fargo, ND

Jason Skiple, PE
Principal/Senior Structural Engineer

Nicole Crist, PE
Project Structural Engineer

06

GATEWAY BY EPIC

310 MAIN AVE, FARGO, ND 58103

OPENED OCTOBER 2021

Gateway by EPIC consists of commercial space and 53 apartments including, studio, one, two, and multi-level units. Surrounded by patrons, this prominent location is sure to benefit any type of business whether retail, office, customer service, and more. Gateway overlooks the Red River and offers all residents a lively downtown lifestyle.

5 Stories • 53 Residential Units
13,000+ SF of Commercial Space • Home to The Fryn' Pan Restaurant

PROJECT DETAILS

Project Cost	$13,300,000
Development Type	Mixed-Use
Project Status	Completed 2021
Funding Source	Private Equity, Traditional Financing, Ren. Zone
Project Timeline	14 Months

06

THE ARCH BY EPIC

300 MAIN AVE, FARGO, ND 58103

UNDER CONSTRUCTION

The Arch by EPIC, phase II of the downtown Gateway development, is a 7-story building featuring commercial space, condos, and apartments. The Arch began construction in summer 2021. This building will be a focal point of the downtown experience by adding additional living to the area. The Arch will have 15 single story apartment units, 15, 2-story apartment units, 34 condos, and 12,600+ SF of commercial space. These residential units will have upscale features and underground parking.

7 Stories • 3 Floors of Condos • 2 Floors of Apartments
12,600+ SF of Commercial Space

PROJECT DETAILS

Project Cost	$31,000,000
Development Type	Mixed-Use
Project Status	Complete 2023
Funding Source	Private Equity, Traditional Financing, Renaissance Zone
Project Timeline	18+ Months

06

BLU ON BROADWAY

1629 SOUTH BROADWAY, MINOT, ND 58702

OPENED OCTOBER 2021

Blu on Broadway is a mixed-use, affordable housing development in Minot, ND. This 5-story building includes 9,000+ SF of 1st floor commercial space and four levels of multi-family affordable housing rental units (42 total). One and two bedroom units range in price from $600-925. Other features include 2-story units, underground parking, outdoor recreation space, a community video board, and more. As the former home of Northern Bottling Company, this location is a substantial landmark along Broadway in Minot.

5 Stories • 42 Apartment Units • 9,000 SF of Commercial Space
Home to X-Golf and Cobalt Nutrition

PROJECT DETAILS

Project Cost	$12,000,000
Development Type	Mixed-Use, Affordable Housing
Project Status	Completed 2021
Funding Source	Private Equity, HUD, NDR,
Project Timeline	16 Months

Partially funded by HUD and CDBG-NDR grant. Guaranteed affordable housing for a 20-year period thanks to the NDR program with the City of Minot. We do business in accordance with the Federal Fair Housing Law.

06

THE LIGHTS

3150 SHEYENNE STREET, WEST FARGO, ND 58078

The Lights is a large development including four mixed-use commercial and residential buildings surrounding an entertainment plaza. A parking garage is on-site to accommodate tenants and traffic. Four distinct buildings will provide more than 120,000 + square feet of premium space for businesses, events, and living. The Essentia Health Plaza at The Lights is home to monthly events including yoga, acoustic concerts, and ice skating - all hosted on a transformable plaza. Combined, the four buildings will host 20+ commercial units and 100+ private residential units, which are currently leased.

3 Buildings • 5 Stories • 100+ Apartments and Condos
120,000+ SF of Commercial Space • Home to Essentia Health Plaza

PROJECT DETAILS

Project Cost	$60,000,000
Development Type	Mixed-Use/Entertainment District
Project Status	Phase I & II Completed 2020 Phase III 2023
Funding Source	Private Equity, TIF, Traditional Financing
Project Timeline	In Progress

EPIC COMPANIES

06

VANNÉ

1530 1ST AVENUE N, MOORHEAD, MN 56560

Vanné is a mixed-use building on 1st Avenue in Moorhead, Minnesota. It is a combination of residential and commercial, creating a community within a community. Located next to Moorhead's own Junkyard Brewing, Sol Ave. Kitchen, and more! This active space is right out your front door. The Community of Moorhead is currently working on a downtown study that will create a downtown location to enhance the lives of its residents.

5 Stories • 33 Residential Units • 9,300 SF of Commercial Space

PROJECT DETAILS

Project Cost	$14,000,000
Development Type	Mixed-Use
Project Status	Completed 2021
Funding Source	Private Equity, City Incentives, Traditional Financing
Project Timeline	12 Months

06

AREA 57

202, 208, 220, & 226 E GREENFIELD LANE, BISMARCK, ND 58503

Area 57 is a master-planned, mixed-use development in Bismarck, ND. It's one of the most unique developments in all of central North Dakota. Its sister locations are The Lights, located at 32nd Avenue and Sheyenne Street in West Fargo, ND and The Beacon by EPIC in Grand Forks, ND.

Phase I of Area 57 includes two buildings with both commercial and residential units. Phase II began construction in the spring of 2021, creating an additional two buildings that will be complete in fall 2022. All the buildings have an attractive and modern design, located next to Bismarck Surgical Associates and The Light of Christ High School.

4 Buildings • 4 Stories • 100+ Residential Units
42,000+ SF of Commercial Space

PROJECT DETAILS

Project Cost	$38,000,000
Development Type	Mixed-Use
Project Status	Phase I Completed 2020 Phase II Under Construction
Funding Source	Private Equity, Traditional Financing
Project Timeline	In Progress

EPIC COMPANIES

06 THE YARDS ON SHEYENNE DOWNTOWN WEST FARGO

SHEYENNE STREET, WEST FARGO, ND 58078

Sheyenne Plaza, Pioneer Place and The Firm are all mixed-use commercial and residential buildings in the heart of downtown West Fargo. Built with a modern, crisp design, adding toward the completion of the downtown West Fargo streetscape. All three properties include community spaces for residents, fitness rooms, patios and underground parking.

SHEYENNE PLAZA

444 Sheyenne Street, West Fargo, ND 58078

PROJECT DETAILS

Project Cost	$11,600,000
Dev. Type	Mixed-Use
Project Status	Completed 2017
Funding Source	Private Equity, Trad. Financing, PPR
Project Timeline	14 Months

5 Stories
22 Residential Units
45,000 SF Commercial Space

PIONEER PLACE

300 Sheyenne Street, West Fargo, ND 58078

PROJECT DETAILS

Project Cost	$13,000,000
Dev. Type	Mixed-Use
Project Status	Completed 2019
Funding Source	Private Equity, Trad. Financing, PPR
Project Timeline	14 Months

5 Stories
51 Residential Units
13,000 SF Commercial Space

THE FIRM

344 Sheyenne Street, West Fargo, ND 58078

PROJECT DETAILS

Project Cost	$8,000,000
Dev. Type	Mixed-Use
Project Status	Completed 2021
Funding Source	Private Equity, Trad. Financing, TIF
Project Timeline	11 Months

3 Stories
26 Residential Units
9,706 SF Commercial Space

HOME TO THE POW/MIA PLAZA $2 MILLION - CITY FUNDED

07 REQUESTED INCENTIVES

If awarded the opportunity to develop the property next to Gateway, EPIC Companies will explore all options possible to make this a walkable, mixed-use center. We will take into consideration incentives such as the current Renaissance Zone and Opportunity Zone in place for this location. Our goal would be to develop a property that caters to downtown Fargo and its surrounding counterparts.

OPPORTUNITY ZONE/RENAISSANCE ZONE

5-YEAR RENAISSANCE ZONE

TRADITIONAL FINANCING

PRIVATE INVESTORS

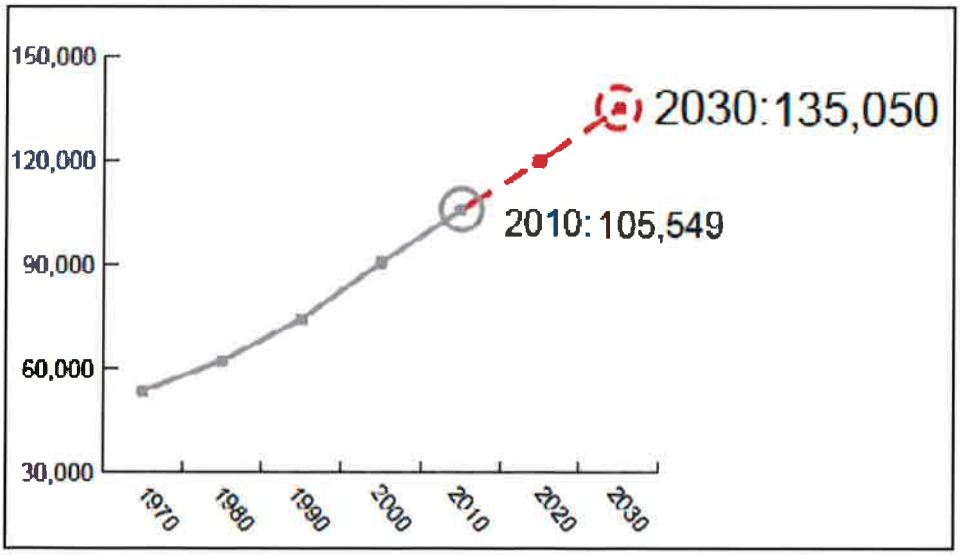
EPIC COMPANIES

07 COMMUNITY PROFILE

This word cloud represents the ideas and input from the public meetings and stakeholder interviews. The larger the word, the more often it was mentioned. Source: wordle.net

AGING POPULATION, INCREASING DIVERSITY

As Fargo grows, its demographics are changing. Fargo's population is becoming older and more diverse. These demographic changes will impact areas such as preferred housing types, transportation options, and the role of education in the community.



From Go2030 Fargo's Comprehensive Plan

POPULATION GROWTH

Fargo is growing quickly. In the past 2 decades Fargo has grown from 74,111 people in 1990 to 105,549 in 2010. Fargo will continue to grow and is projected to reach 135,050 people by 2030. Adding nearly 30,000 people to Fargo while increasing the quality of life for existing and future residents will require careful planning and visionary leadership.

07 CONSTRUCTION TIMELINE

The Construction Process would begin Summer of 2022 with construction limits and security fencing being established and installed. From that point, based on the proposed building design, deep foundation and excavation work would commence followed by concrete foundations. Once concrete foundations are ready, the precast concrete podium structure & circulation towers would be erected with concrete toppings poured.

The project would then transition into framing and dry in of the building. Once the building is dried in, rough-ins would commence with insulation, drywall, and finishes being completed on each floor respectively starting at the 7th floor, working down the building. Summer of 2023 would provide for the ability to install site utilities, paving, etc. with landscaping being complete late summer/early fall of 2023. Rough timeline would provide for a building opening end of year 2023.

Task	Duration	Start	Finish
Proposed Start 6/1/22	**395 days**	**06/01/22**	**12/01/23**
Deep Foundations & Excavation	4 weeks	06/01/22	06/26/22
Foundations	6 weeks	06/29/22	08/07/22
Podium & Toppings	6 weeks	06/10/22	09/18/22
Framing	20 weeks	07/21/22	02/05/23
Dry-In	4 weeks	02/08/23	03/02/23
Rough-In	14 weeks	03/05/23	06/10/23
Utilities/Paving/Sitework	6 weeks	07/01/23	08/12/23
Insulation & Drywall	2 weeks	07/03/23	07/21/23
Finishes	10 weeks	08/15/23	10/20/23
Building Turnover	4 weeks	10/23/23	11/18/23
Landscaping & Final Site Items	2 weeks	11/21/23	12/01/23

07 PROPOSED PRICE

OUR OFFER:

EPIC proposes to pay $22/SF for 54,000 SF of land at 1 2nd Street S, Fargo, ND or in the amount of $1,188,000.

07 REFERENCES

11/01/2021

Re: EPIC Companies

Bank Forward has had the pleasure of working with EPIC Companies of numerous projects and I personally have worked them in the past on 5+ large scale commercial mixed use/development projects before moving over to Bank Forward. Each and every project we have financed has turned out exactly as it was presented up front upon initial development in terms of cost and completion dates. Their projects are designed to elevate the surrounding properties and provide value to the communities in which they are built. They truly care of the about communities they are apart of, which is sometimes not the norm. We are grateful to have the opportunities to work with Epic now and in the future.

Regards,

Marc Knutson

Market President – Fargo

Bank Forward

701.532.4081 (D)

Marc.Knutson@BankForward.com

5850 37th Ave S | Fargo, ND 58104 | T701.293.9540 | F701.293.3338 | bankforward.com

07 REFERENCES

11/10/2021

From: Matt Marshall

This letter is intended to confirm EPIC Companies' experience working on a variety of development and redevelopment projects. In my time as Economic Development Director for the City of West Fargo, EPIC Companies completed multiple projects working with the city, Bank of North Dakota, and private investors to bring projects together. Tax Increment Financing: EPIC Companies worked with the City of West Fargo, Cass County, and local schools to receive tax increment financing to complete public and private projects. State statute allows a city to use the incremental increase in taxes to help projects get completed that would not otherwise happen. EPIC Companies allowed the city to use the increments they were paying to build public infrastructure such as a parking ramp, plaza space, and other associated infrastructure. In other projects, EPIC and the city used tax increments to remove old buildings in order to prepare the underlying sites for development.

Bank of North Dakota: The Bank of North Dakota offers financing programs that buy down interest. EPIC Companies worked with the City of West Fargo and lead lenders to combine programs and take full advantage of interest buy down. EPIC Companies also worked with the Bank of North Dakota on new financing programs surrounding public infrastructure that was unique to their projects and not part of a standard program.

Public Private Partnership: EPIC is the sole developer in West Fargo's downtown. Because of the complexity involved in starting a major redevelopment, the city and EPIC Companies entered into a Public Private Partnership. Unique to the state of North Dakota, the agreement included a land lease, public amenities, and complex financing through a bank group formed by EPIC. Recently, EPIC worked with the city on approval for the fifth multistory building which will include a parking structure.

If I can provide any additional details on a particular project or answer any questions, please feel free to contact me at 701-630-4658.

Sincerely,

Matt Marshall

07 REFERENCES

City of WEST FARGO
a city on the grow

11/14/2021

To Whom It May Concern:

It is my pleasure to write to you about the City of West Fargo's experience with EPIC Companies in redevelopment and development efforts in the City of West Fargo.

Over the past 20 years, the City of West Fargo has more than doubled in population and land area. While much of the City's focus has been on booming residential and commercial development, a relationship with EPIC has allowed us to focus on amenities, community development and the intangible elements that makes a place special.

Our public-private partnership with EPIC delivered more than $40 million in redevelopment to our downtown along Sheyenne Street. This revival includes five new mixed-use buildings, a civic plaza, branding and future street improvements to promote walkability and livability in the area. The total return on the City of West Fargo's investment will be close to $5.3 million. Due to these efforts, the City of West Fargo was named a Main Street Community in 2018 and awarded North Dakota Governor Burgum's Main Street Excellence Award in 2019.

The partnership with EPIC has not only revitalized our downtown, but also led to strategic development on the south side. The Lights at Sheyenne 32 is an innovative live, work and play development that includes four mixed use buildings, a central plaza space for community events and West Fargo's first parking garage.

Sincerely,

Tina Fisk, City Administrator
City of West Fargo
Email: tina.fisk@westfargond.gov
Phone: 701-433-5300

800 Fourth Ave. E., Suite 1 West Fargo, ND 58078 | (701) 433-5300 | westfargond.gov

EPIC COMPANIES

07 REFERENCES

City of Minot

11/03/2021

This letter is written to confirm that the Epic Companies is in the midst of the construction of a mixed used partially HUD CDBG-NDR funded project in the City of Minot. The project is both privately and publicly funded to infuse new investment in an area of the City in need of it with this project to house both commercial uses as well as Low/Moderate Income rental apartment units.

The project and the company went through an extensive due diligence process as is required by HUD CDBG rules which resulted in an exciting model project for the use of HUD CDBG funds as leverage through the development agreement that was approved by the Minot City Council.

The City also has experience with Epic Companies through its work and support of a non-profit corporation, Essential Living, with which the City has entered both development and sub-recipient agreements for provision of Low/Moderate income rental units.

One project has been successfully completed and as a result of the success of that project, the City has provided funding for a second project which is currently underway.

The mixed use project with Epic Companies, known as Blu on Broadway, is on schedule, has met all required deliverables and private financing obligations, and construction is underway.

Sincerely,

John R. Zakian
City of Minot
Disaster Recovery Grant Program Manager &
Chief Resilience Officer

07 REFERENCES

FIRST WESTERN
BANK & TRUST
You can bank on us
P.O. Box 1090 • Minot, ND 58702-1090 • 701-852-3711

11/05/2021

My name is Jersey Benson, Vice President and Business Banking Manager of First Western Bank & Trust headquartered in Minot, ND. This letter is intended to express my unbiased opinion of Epic Companies and reference the relationship we have established along with identifying the company's ability to provide affordable housing while meeting the compliance requirements.

Our relationship began in 2017 regarding a new affordable housing project located in Minot, ND. This particular project renovated an existing three-story building into a 41-unit complex designed to be occupied by low to moderate income citizens who may qualify pursuant to the Department of Housing and Urban Development and the North Dakota Housing Finance Agency. As of today, this project is fully stabilized providing the necessary affordable housing needed within the community.

Based on our review, Epic Companies have appropriately met the requirements and criteria to continue providing affordable housing. In fact, we currently have two more affordable housing projects that have been approved and we are proud to partner with Epic Companies. The team at Epic Companies has the ability to provide any requested material regarding compliance in a very detailed and timely manner. Therefore, Epic Companies is highly qualified to develop and sustain affordable housing projects.

Over the last three years the relationship between Epic Companies and First Western Bank & Trust has been exceptional. As a community financial institution, it is our mission to support impactful community projects and we feel Epic Companies management and expertise in affordable housing can continue to make impactful projects to communities across North Dakota. If you have any questions please don't hesitate to contact me.

Sincerely,

Jersey Benson
FIRST WESTERN BANK & TRUST
V.P. & Business Banking Manager

07 REFERENCES

COLDWELL BANKER

1ST MINOT REALTY, INC.

219 S. MAIN STREET
MINOT, ND 58701

(701) 852-0156

11/01/2021

Re: EPIC Companies

To Whom It May Concern:

Nearly ten years ago, I had the opportunity to work with Minot State University Foundation and Todd Berning of EPIC Companies to build a mixed-use development called Beaver Ridge. This development was the first of its kind in Minot and was right across from the campus of Minot State University. Beaver Ridge provided housing for many MSU students and some highly desired new commercial space on the main floor of the building.

As a real estate developer myself I see the importance that mixed-use developments provide for a community. I believe in the process that EPIC Companies uses to deliver a project from start to finish. Recently, EPIC was awarded another mixed-use development with the City of Minot called Blu on Broadway which will be another benefit to the community.

These types of developments require high levels of coordination and planning in order to succeed. Everything from design, financing, city approvals, development agreements, and into the construction and management, EPIC knows how to deliver. I have first-hand experience working with EPIC on other projects that involved creative financing solutions, multiple governmental agencies funding, compliance and oversight. Throughout these projects we have worked hand in hand to build a relationship that continues to carry on over time. As a member of the National Association of Home Builders, and in the past serving on the National Board, I have had the opportunity to share experiences related to development with other Association members. Developers all across the country agree that deadlines and budgets are extremely important to the development process and this is something EPIC Companies excels at.

We have been pleased with the process of communicating and working with EPIC. I highly recommend EPIC Companies as a mixed use developer. Feel free to contact me with any questions.

Sincerely,

F. Bruce Walker, Owner/Broker

Coldwell Banker 1st Minot Realty and Management Inc.

UND graduate 1972

Each Office Is Independently Owned and Operated

ENHANCING COMMUNITIES THROUGH INNOVATIVE DEVELOPMENT.

Proposal Submission:
November 17, 2021

EPIC COMPANIES
Investment • Development • Management

THE CITY OF Fargo
FAR MORE

EPIC Companies I 745 31st Avenue E, Ste 105, West Fargo, ND 58078 I 701.866.1006 I EPICCompaniesND.com

THE CITY OF Fargo FAR MORE

27

City Administration
225 4th Street North
Fargo, ND 58102

MEMORANDUM

TO: **Fargo City Commission**

FROM: **Jim Gilmour, Director of Strategic Planning and Research**

DATE: **February 16, 2022**

SUBJECT: **Sale of 419 3rd Street North**

By your meeting time, there may be a recommendation to sell City of Fargo property at 419 3rd Street North for redevelopment. The Economic Development Incentives Committee and Renaissance Zone Authority are scheduled to meet at 1:00 p.m. on Tuesday, February 22 and the sale of this property is on its agenda for discussion and a possible recommendation.

Background

The Fargo City Commission directed preparation of a Riverfront Renewal Plan in October 2020. The Riverfront Renewal plan was completed and adopted by the City Commission in April 2021. This plan included actions to sell several city owned properties for redevelopment.

Request for proposals and selection criteria for the three properties were approved by the City Commission in September and October 2021. Proposals were due in November. Two proposals were submitted, one of which has three different development options.

Agenda Item:

Discuss and consider offers for 419 3rd Street North.

THE CITY OF Fargo
FAR MORE

29

Engineering Department
225 4th Street North
Fargo, ND 58102
Phone: 701.241.1545 | Fax: 701.241.8101
Email feng@FargoND.gov
www.FargoND.gov

February 17, 2022

Honorable Board of
City Commissioners
225 4th Street N
Fargo, ND 58102

Re: Reject All Bids Recommendation
32nd Avenue S Reconstruction Project – 32nd Street to 22nd Street
City of Fargo Improvement District No. BR-22-A1
NDDOT Project No. SU-CVD-8-984(168)

Dear Commissioners:

Bids were opened by the NDDOT on Friday, February 11, 2022 for the 32nd Avenue South Reconstruction project.

The bids were as follows:

Dakota Underground Company	$ 16,632,098.77
Park Construction	$ 18,042,014.19
Northern Improvement Company	$ 19,186,258.74
Engineer's Estimate	$ 11,732,741.20

There are Special Assessments associated with this project and with the low bid price being greater than 40% of the Engineer's Estimate, State Law states we must reject all bids and not award.

We plan on completing a value engineering process on the current design in the next month and will come back to the Commission with our findings. We will rebid the project this fall, for a 2023 construction project.

Recommended Motion
Reject all bids for the project and plan to rebid project in October 2022 for a 2023 construction project.

Sincerely,

Brenda E. Derrig, P.E.
City Engineer

CITY OF Fargo

ASSESSMENT DEPARTMENT

3/a

February 11, 2022

Board of City Commissioners
City Hall
Fargo, ND 58102

Dear Commissioners:

Chapter 57-02.2 of the North Dakota Century Code provides for a property tax exemption for certain types of improvements made to existing buildings.

I have attached a copy of an application for real estate tax exemption of building improvements for the property at 3024 37 Ave S as submitted by Glenn and Ann Shamdas. A description of the property involved, types of improvements to be made, and assessment information are indicated on the application.

It is my opinion that the value of some of the improvements, referred to in the application, qualifies for the exemption. This exemption would be for 5 years.

The estimated annual tax revenue lost by granting the exemption, based upon the estimated cost of the improvements, would be about $370 with the City of Fargo's share being $60.

Sincerely,

Mike Splonskowski
City Assessor

nlb
attachment

* Needs Abatement *

Application For Property Tax Exemption For Improvements To Commercial And Residential Buildings

North Dakota Century Code ch. 57-02.2

(File with the local city or township assessor)

Property Identification

1. Name of Property Owner Glenn & Ann Shamdas Phone No. 701.866.5595
2. Address of Property 3024 37 Ave S

   City FARGO State ND Zip Code 58104
3. Legal description of the property for which the exemption is being claimed. Lt 13 Blk 2 Stonebridge Farms 2nd
4. Parcel Number 01-2922-00510-000 Residential ☒ Commercial ☐ Central Business District ☐
5. Mailing Address of Property Owner Same

   City State Zip Code

Description Of Improvements For Exemption

6. Describe the type of renovating, remodeling or alteration made to the building for which the exemption is being claimed (attach additional sheets if necessary). Kitchen remodel
7. Building Permit No. 20070319 8. Year Built 1993
9. Date of Commencement of making the improvement 9/14/20
10. Estimated market value of property before improvement $ 362,900
11. Cost of making the improvement (all labor, material and overhead) $ 40,000
12. Estimated market value of property after improvement $

Applicant's Certification and Signature

13. I certify that the above information is correct to the best of my knowledge and I apply for this exemption.

    Applicant's Signature Ann M. Shamdas Date 12/14/20

Assessor's Determination

14. The local assessor finds that the improvements in this application has ☑ has not ☐ met the qualifications for exemption for the following reason(s):

    Assessor's Signature [signature] Date 2-11-2021

Action of Governing Body

15. Action taken on this application by local governing board of the county or city: Denied ☐ Approved ☐

    Approval subject to the following conditions:

    Chairman of Governing Body Date

Submit Via Email

CITY OF Fargo

ASSESSMENT DEPARTMENT

316

February 2, 2022

Board of City Commissioners
City Hall
Fargo, ND 58102

Dear Commissioners:

Chapter 57-02.2 of the North Dakota Century Code provides for a property tax exemption for certain types of improvements made to existing buildings.

I have attached a copy of an application for real estate tax exemption of building improvements for the property at 405 23 Ave N as submitted by Karen L T/O/D Breivold. A description of the property involved, types of improvements to be made, and assessment information are indicated on the application.

It is my opinion that the value of some of the improvements, referred to in the application, qualifies for the exemption. This exemption would be for 5 years.

The estimated annual tax revenue lost by granting the exemption, based upon the estimated cost of the improvements, would be about $170 with the City of Fargo's share being $30.

Sincerely,

Mike Splonskowski
City Assessor

nlb
attachment

Application For Property Tax Exemption For Improvements To Commercial And Residential Buildings

N.D.C.C. ch. 57-02.2

(File with the city assessor or county director of tax equalization)

Property Identification

1. Legal description of the property for which exemption is claimed Lt 8, Blk 4, Louise S Newman
2. Address of Property 405 23 Ave N
3. Parcel Number 01-2080-00490-000
4. Name of Property Owner BREIVOLD, KAREN L T/O/D Phone No.
5. Mailing Address of Property Owner Same

Description Of Improvements For Exemption

6. Describe type of renovating, remodeling, alteration or addition made to the building for which exemption is claimed (attach additional sheets if necessary). Full bath remodel
7. Building permit No. 2110-0920
8. Year built (residential property) 1954
9. Date of commencement of making the improvements 10/27/2021
10. Estimated market value of property before the improvements $ 167,500.00
11. Cost of making the improvement (all labor, material and overhead) $ 17,000.00
12. Estimated market value of property after the improvements $ 179,800.00

Applicant's Certification And Signature

13. I certify that the information contained in this application is correct to the best of my knowledge.

Applicant Karen L Breivold Date 01-21-2022

Assessor's Determination And Signature

14. The assessor/county director of tax equalization finds that the improvements described in this application do ☑ do not ☐ meet the qualifications for exemption for the following reason(s):

Assessor/Director of Tax Equalization Date 2-15-2022

Action Of Governing Body

15. Action taken on this application by the governing board of the county or city: Approved ☐ Denied ☐

Approval is subject to the following conditions:

Exemption is allowed for years 20___, 20___, 20___, 20___, 20___.

Chairperson Date

24840 (Rev. 6-01)

CITY OF Fargo

ASSESSMENT DEPARTMENT

3lc

February 4, 2022

Board of City Commissioners
City Hall
Fargo, ND 58102

Dear Commissioners:

Chapter 57-02.2 of the North Dakota Century Code provides for a property tax exemption for certain types of improvements made to existing buildings.

I have attached a copy of an application for real estate tax exemption of building improvements for the property at 3301 Bohnet Blvd N as submitted by Richard and Charlotte Feldman. A description of the property involved, types of improvements to be made, and assessment information are indicated on the application.

It is my opinion that the value of some of the improvements, referred to in the application, qualifies for the exemption. This exemption would be for 5 years.

The estimated annual tax revenue lost by granting the exemption, based upon the estimated cost of the improvements, would be about $245 with the City of Fargo's share being $40.

Sincerely,

Mike Splonskowski
City Assessor

nlb
attachment

Application For Property Tax Exemption For Improvements To Commercial And Residential Buildings

N.D.C.C. ch. 57-02.2

(File with the city assessor or county director of tax equalization)

Property Identification

1. Legal description of the property for which exemption is claimed Lt 18, Blk 3, Golf Course 5th
2. Address of Property 3301 Bohnet Blvd N
3. Parcel Number 01-1005-00450-000
4. Name of Property Owner Richard & Charlotte Feldman Phone No. 218-790-5277
5. Mailing Address of Property Owner Same

Description Of Improvements For Exemption

6. Describe type of renovating, remodeling, alteration or addition made to the building for which exemption is claimed (attach additional sheets if necessary). Kitchen remodel
7. Building permit No. 2110-0687
8. Year built (residential property) 1978
9. Date of commencement of making the improvements 10/27/2021
10. Estimated market value of property before the improvements $ 248,900.00
11. Cost of making the improvement (all labor, material and overhead) $ $ 50,000
12. Estimated market value of property after the improvements $ 267,500

Applicant's Certification And Signature

13. I certify that the information contained in this application is correct to the best of my knowledge.

Applicant Charlotte Feldman Date 2-3-22

Assessor's Determination And Signature

14. The assessor/county director of tax equalization finds that the improvements described in this application do ☑ do not ☐ meet the qualifications for exemption for the following reason(s):

Assessor/Director of Tax Equalization [signature] Date 2-15-2022

Action Of Governing Body

15. Action taken on this application by the governing board of the county or city: Approved ☐ Denied ☐

Approval is subject to the following conditions:

Exemption is allowed for years 20___, 20___, 20___, 20___, 20___.

Chairperson _____ Date _____

24840 (Rev. 6-01)

CITY OF Fargo

ASSESSMENT DEPARTMENT

31d

February 4, 2022

Board of City Commissioners
City Hall
Fargo, ND 58102

Dear Commissioners:

Chapter 57-02.2 of the North Dakota Century Code provides for a property tax exemption for certain types of improvements made to existing buildings.

I have attached a copy of an application for real estate tax exemption of building improvements for the property at 1253 11 ½ St N as submitted by Kathryn Ulmer. A description of the property involved, types of improvements to be made, and assessment information are indicated on the application.

It is my opinion that the value of some of the improvements, referred to in the application, qualifies for the exemption. This exemption would be for 5 years.

The estimated annual tax revenue lost by granting the exemption, based upon the estimated cost of the improvements, would be about $250 with the City of Fargo's share being $40.

Sincerely,

Mike Splonskowski
City Assessor

nlb
attachment

Application For Property Tax Exemption For Improvements To Commercial And Residential Buildings

N.D.C.C. ch. 57-02.2

(File with the city assessor or county director of tax equalization)

Property Identification

1. Legal description of the property for which exemption is claimed Pt of Lt 52 Ohmers
2. Address of Property 1253 11 1/2 St N
3. Parcel Number 01-2220-02980-000
4. Name of Property Owner Kathryn Ulmer Phone No. 701-212-6790
5. Mailing Address of Property Owner Same

Description Of Improvements For Exemption

6. Describe type of renovating, remodeling, alteration or addition made to the building for which exemption is claimed (attach additional sheets if necessary). Kitchen & Bath remodel
7. Building permit No. 2110-0805 8. Year built (residential property) 1928
9. Date of commencement of making the improvements 11/10/2021
10. Estimated market value of property before the improvements $ 163,200.00
11. Cost of making the improvement (all labor, material and overhead) $ 25,000.00
12. Estimated market value of property after the improvements $ 182,100

Applicant's Certification And Signature

13. I certify that the information contained in this application is correct to the best of my knowledge.

Applicant Kathryn Ulmer Date 2/3/2022

Assessor's Determination And Signature

14. The assessor/county director of tax equalization finds that the improvements described in this application do ☒ do not ☐ meet the qualifications for exemption for the following reason(s):

Assessor/Director of Tax Equalization [signature] Date 2-15-2022

Action Of Governing Body

15. Action taken on this application by the governing board of the county or city: Approved ☐ Denied ☐

Approval is subject to the following conditions:

Exemption is allowed for years 20___, 20___, 20___, 20___, 20___.

Chairperson Date

24840 (Rev. 6-01)

CITY OF Fargo

ASSESSMENT DEPARTMENT

3le

February 7, 2022

Board of City Commissioners
City Hall
Fargo, ND 58102

Dear Commissioners:

Chapter 57-02.2 of the North Dakota Century Code provides for a property tax exemption for certain types of improvements made to existing buildings.

I have attached a copy of an application for real estate tax exemption of building improvements for the property at 2013 30 Ave S as submitted by Aaron Wolters. A description of the property involved, types of improvements to be made, and assessment information are indicated on the application.

It is my opinion that the value of some of the improvements, referred to in the application, qualifies for the exemption. This exemption would be for 5 years.

The estimated annual tax revenue lost by granting the exemption, based upon the estimated cost of the improvements, would be about $280 with the City of Fargo's share being $50.

Sincerely,

Mike Splonskowski
City Assessor

nlb
attachment

Application For Property Tax Exemption For Improvements To Commercial And Residential Buildings

North Dakota Century Code ch. 57-02.2

(File with the local city or township assessor)

Property Identification

1. Name of Property Owner Aaron Wolters Phone No. 701/388-1006
2. Address of Property 2013 30th Ave. S.

   City FARGO State ND Zip Code 58103
3. Legal description of the property for which the exemption is being claimed.

   Lot E 35 FT of 3 + W 33 FT of 4 Block 2 Rheault Add'n
4. Parcel Number 01-2350-00110-000 Residential ☒ Commercial ☐ Central Business District ☐
5. Mailing Address of Property Owner Same

   City State Zip Code

Description Of Improvements For Exemption

6. Describe the type of renovating, remodeling or alteration made to the building for which the exemption is being claimed (attach additional sheets if necessary). Gut + Remodel existing home
7. Building Permit No. 21050586 8. Year Built
9. Date of Commencement of making the improvement 5/21/21
10. Estimated market value of property before improvement $ 187,800
11. Cost of making the improvement (all labor, material and overhead) $ 25,000
12. Estimated market value of property after improvement $ 202,100

Applicant's Certification and Signature

13. I certify that the above information is correct to the best of my knowledge and I apply for this exemption.

    Applicant's Signature [signature] Date 2/4/2022

Assessor's Determination

14. The local assessor finds that the improvements in this application ☒ has ☐ has not ☐ met the qualifications for exemption for the following reason(s):

    Assessor's Signature [signature] Date 2-15-2022

Action of Governing Body

15. Action taken on this application by local governing board of the county or city: Denied ☐ Approved ☐

    Approval subject to the following conditions:

    Chairman of Governing Body Date